

# “Anglers' Fishing Choices on the Truckee, Carson, and Walker Rivers and the Threat of the New Zealand Mud Snail”

*Final Report to the Pacific States Marine Fisheries Commission  
and the  
U.S. Fish and Wildlife Service*

June 27, 2006

Principal Investigator:

Klaus Moeltner,  
Associate Professor  
Department of Resource Economics, University of Nevada, Reno  
MS 204  
Reno, NV 89557-0105  
Phone: (775) 784-4804 / Fax: (775) 784 -1342  
e-mail: moeltner@cabnr.unr.edu

I am thankful to Dr. Alison Davis for the computation of travel distances, to Jake Burkey and Margaret Cowee for the design and implementation of the web version of this survey, and to Laine Christman for excellent technical assistance.

I am also indebted to the staff of the Nevada Division of Wildlife, Reno Office, most notably Kim Tisdale, Fisheries Biologist, Western Region, for supplying key information on visitation counts and fishing quality throughout the Truckee / Carson / Walker watershed, and for providing valuable input into the design of our survey instrument. I would also like to thank Ralph Cutter from the California School of Fly Fishing for his helpful comments throughout this research effort.

This research was jointly sponsored by the U.S. Fish and Wildlife Service through a cooperative agreement with the Pacific States Marine Fisheries Commission (Project #11332-2-J008), and a University of Nevada, Reno, Junior Faculty Research Grant (Grant #1209-121-0093).

**Contents:**

<u>Section</u>	<u>Page</u>
I) Executive Summary	i
II) Background Information and Research Objectives	1
III) Survey Implementation and General Survey Statistics	7
IV) Survey Results	8
1) Demographic Information	8
2) General Fishing and License Information	10
3) Mud Snail Awareness and Containment	13
4) Fishing History	15
5) Fishing Decisions under Hypothetical Policy Changes	18
6) Trip Expenditures	22
7) Travel Distances	24
V) Conclusions / Next Steps	27
VI) References	28

**Appendices:**

<u>Appendix</u>	<u>Page</u>
Appendix A: Survey Questionnaire	30

**Tables:**

<u>Table</u>	<u>Page</u>
<i>Background information / General Survey Statistics</i>	
Table 1: Angler counts and visitation days for the TCW watershed, 1994-2002	4
Table 2: Angler counts by origin (residence) for the 2002 season	5
Table 3: General survey statistics	7
<i>Demographic Information</i>	
Table 4: Angler composition by gender	8
Table 5: Angler composition by age	8
Table 6: Angler composition by household type	8
Table 7: Angler composition by education level	9
Table 8: Angler composition by household income	9
Table 9: Angler composition by state of residence	9
<i>General Fishing and License Information</i>	
Table 10: Holding of CA license in 2004	10
Table 11: License mix for 2005	10
Table 12: Fishing experience	10
Table 13: Fishing techniques	11
Table 14: Spin casting techniques	11
Table 15: Wading habits	11
Table 16: Fish-keeping habits	11
Table 17: Importance of various fishing site attributes	12
<i>Mud Snail Awareness and Containment</i>	

Table 18: Previous awareness of the NZMS	13
Table 19: Sources of Information on the NZMS	13
Table 20: Containment measures taken by previously aware anglers	14
Table 21: Future use of containment measures by previously unaware anglers	14
Table 22: Fishing at specific risk sites in 2004/2005 by awareness / containment type	14
Table 23: Fishing at <i>any</i> risk site by awareness / containment type	14
<i>Fishing History</i>	
Table 24: Visitation counts by river section and year	16
Table 25: Per-person visitation statistics by river section and year	16
Table 26: Preferred segment of section T4	17
Table 27: Preferred segment of section C4	17
Table 28: Preferred segment of section W4	17
Table 29: Per-person visitation statistics for overnight trips and trips outside the TCW system	17
Table 30: Total counts for day trips and overnight trips within and outside the TCW system	17
<i>Fishing Decisions under Hypothetical Quality Changes</i>	
Table 31: Effect of catch & release for section T4 on the purchase of a NV license	19
Table 32: Effect of catch & release for section T4 on trips to T4	19
Table 33: Effect of catch & release for section C4 on the purchase of a NV license	19
Table 34: Effect of catch & release for section C4 on trips to C4	19
Table 35: Effect of catch & release for section W4 on the purchase of a NV license	20
Table 36: Effect of catch & release for section W4 on trips to W4	20
Table 37: Effect of closure of section T3 on the purchase of a NV license	20
Table 38: Effect of closure of section T3 on overall trips	20
Table 39: Effect of closure of section T4 on the purchase of a NV license	21
Table 40: Effect of closure of section T4 on overall trips	21
Table 41: Effect of closure of section W3 on the purchase of a NV license	21
Table 42: Effect of closure of section W3 on overall trips	21
<i>Trip Expenditures</i>	
Table 43: Day trip expenditures by residency	22
Table 44: Overnight trip expenditures by residency	23
<i>Travel Distances</i>	
Table 45: Travel distances by residency	25

## **Figures:**

<b><u>Figure</u></b>	<b><u>Page</u></b>
Figure 1: Spread of the NZMS over the last ten years	6
Figure 2: Documented occurrences of the NZMS in the Western U.S.	6
Figure 3: Respondent origins and fishing destinations in the TCW system	26

## **I) Executive Summary**

This report describes the findings from a combined mail / internet survey of anglers who obtained a Nevada fishing license for the 2004 fishing season. The survey examined these anglers' fishing preferences and site choices in the Truckee / Carson / Walker (TCW) river system in Northern Nevada. In specific, the survey focused on the current status of anglers' awareness of the New Zealand Mud Snail (NZMS) threat, and, given such awareness, the containment methods they use to prevent a further spread of the snail. The survey also elicited information on anglers' propensity to purchase a season license and to take trips to the TCW system under hypothetical changes in fishing regulations and site closures, as they may arise in response to a snail infestation.

The survey was an integral component of an ongoing research project at the University of Nevada, Reno, titled "*Assessment of angler awareness, contamination risk, and economic implications of a New Zealand mud snail infestation of the Truckee / Carson / Walker watersheds*". The survey provided essential data to allow for a subsequent analysis of the potential economic effects of a change in fishing quality and / or fishing regulations caused by a NZMS invasion of the TCM watershed.

The survey was implemented in five rounds during the period of November 2005 to February, 2006. The initial round of questionnaires was mailed to 1800 anglers, randomly chosen from a sample frame of 28,331 license holders. The survey collected 754 valid responses, which amounts to a satisfactory response rate of close to 50%, given a 16% rate of undeliverable questionnaires.

Survey results indicate that the TCW system is an important recreational fishery, judged both by the number of angler visits and angler expenditures flowing to the regional economy. In total, the anglers represented in our sample took between 3000 and 4000 day trips to the TCW system in 2004 and 2005. Extrapolating these figures to the entire population of Nevada license holders yields an estimated total number of 110,000 to 140,000 seasonal day trips to the three-river system. Similarly, the total number of overnight trips to TCW fishing sites can be derived to lie between 10,000 and 12,000 visits per season. The average angler spends about \$60 on a day trip and \$150 on an overnight trip. This translates into total population expenditures of \$8-10 million on trips to the TCW system per season.

With respect to NZMS awareness and containment, we find that much needs to be done to increase awareness levels of the general population of anglers, and to create incentives for anglers to take snail-averting measures. For our sample, close to 80% of anglers were either unaware of the NZMS threat or were aware but did not take any containment measures in the past. With respect to the risk of a mud snail infestation of the TCW system, this finding of low awareness / containment is exacerbated by the facts that close to 15% of our sample fished at infested waters outside the TCW region in 2004 and 2005, and almost half of the respondents stated a preference for wading while fishing.

As anglers' responses to our hypothetical policy scenarios indicate, waiting for the snail to arrive at the TCW system before taking combating measures may be costly – both in terms of reduced license sales and reduced trips to the system, with associated losses in revenue to the local economy.

The exact derivation of the economic implications of deterioration of fishing quality at the three rivers due to a hypothetical snail infestation is subject to the next step of this research. We will combine data on trip choices and angler characteristics collected through this survey with information on fishing quality and other physical attributes of TCM fishing sites to estimate an economic demand model for the TCW fishery. By setting explanatory quality variables such as fish / mile and average fish size to levels that may be expected in case of a snail infestation, and by varying regulatory measures such lure / size/ bag restrictions and site closures, this model will allow for the prediction of trips and economic welfare (consumer surplus) for a variety of hypothetical "snail scenarios". In turn, the estimated reduction in predicted trips corresponding to a specific infestation scenario will allow for the computation of estimated losses in fishing trip-related revenues to the wider region.

We hope that the findings flowing from this research will provide fishery managers with a clearer understanding of the risk of a NZMS contamination of the TCW system, and with useful decision input when weighing the pros and cons associated with specific snail-averting strategies.

## **II) Background Information and Research Objectives**

### *Introductory Note*

This report describes the findings from a combined mail / web survey of anglers who obtained a Nevada fishing license for the 2004 / 2005 season. The survey was an integral component of an ongoing research project at the University of Nevada, Reno, titled

*“Assessment of angler awareness, contamination risk, and economic implications of a New Zealand mud snail infestation of the Truckee / Carson / Walker watersheds”*

Subsequent research will use the survey data to derive the economic effects of a change in fishing quality that could arise due to a New Zealand Mud Snail Infestation in the Truckee / Carson / Walker system.

### *The New Zealand mud snail invasion of the Western U.S.*

The New Zealand mud snail (*Potamopyrgus antipodarum*) is a nonindigenous gastropod that has become established over the last two decades in a variety of aquatic habitats throughout the Western United States. It was first discovered in the mid-Snake River in Idaho in the 1980s, and has since rapidly spread to other watersheds in ten Western States, including three National Parks. As illustrated in Figure 1, the spread of the snail has been especially accelerated over the last ten years.

The New Zealand mud snail (NZMS) is a parthenogenic livebearer with tremendous reproductive potential. As pointed out in Richards (2002), under theoretically ideal conditions a single female can be responsible for over three billion offspring in less than a year. Not surprisingly, colonies of NZMSs have been reported to reach densities as high as 750,000 / m<sup>2</sup> in suitable habitats comprising over 95% of the invertebrate biomass in a river (Department of Ecology, MSU, 2005). These observed impressive rates of proliferation are largely attributable to the absence of specific trematode parasites that curb the snail's spread in its native New Zealand waters. Furthermore, given its relatively hard shell and a hardened operculum that can close during adverse conditions, the snail is largely indigestible to potential predators. The to date limited scientific research on the NZMS and its implications for the aquatic ecosystems it invades indicates that the snail has the potential to overtake and degrade entire ecosystems through its competition with native invertebrates for habitat and food sources (Cada, 2004, Kerans et al., 2005), its nitrogen-rich excretion fluxes (Robert O. Hall Jr. et al. 2003), and its potential to host vertebrate parasites (Staton et al., 2003).

Given the snail's documented competitive edge for habitat and food at the detriment of traditional food sources for trout and other game fish, and its own poor nutritional value to these fish populations, the arrival of the NZMS has naturally triggered strong concerns regarding the future health of affected fisheries. While more research is needed to gain clarity on the impacts of NZMS infestations on the vertebrate fauna, preliminary scientific findings indicate that large densities of mud snails can lead to a reduced growth in fishes (Cada et al., 2003). In addition, empirical observations by fishery managers and outfitters indicate a pronounced reduction in hatches of aquatic insects in infested waters, including some of the nation's premier trout streams (Cutter, 2004). As stated in Richards (2002), and in various agency outlets (e.g. Colorado Division of Wildlife, 2005), it is the general consensus amongst scientists and water managers that the NZMS will have a significant and potentially permanent negative impact on western fisheries.

The NZMS threat is aggravated by the fact that these invaders are very small (generally less than 1/8 inch), and can survive for long periods of time in moist environments (Cutter, 2004). These characteristics facilitate the spread of the snail across watersheds through human activities as the snail can become an undetected "hitchhiker" on fishing gear, boots and waders, and construction material. The

NZMS's distribution through human vectors is now widely considered the main reason for the snail's rapid inter-shed spread in recent years (e.g. Yellowstone National Park Service, 2003). Given this involuntary potential for anglers to facilitate the snail's expansion, and the to date unsuccessful attempts to (safely) eliminate the snail once it has become established, prevention of infestation through enhancement of public awareness and induction of snail-averting angler behavior is considered the most important management tool by experts and managers alike (e.g. Department of Ecology, MSU, 2005, Yellowstone National Park Service, 2003).

*The threat to the Truckee / Carson / Walker watershed and associated economic considerations*

In recent years, the snail has made landfall in aquatic systems near the northeastern corner of Nevada, and near its southwestern border with California. Specifically, the snail is now well established in the Lower Owens River near Bishop, CA, with density estimates of 10,000 to 20,000/ m<sup>2</sup> (Richards, 2002). To date, no occurrence of the NZMS has been reported for the Truckee / Carson / Walker River watershed (TCWW). As evident from Figure 2, the Owens watershed is geographically close to the TCWW. More importantly, both water systems are considered prime fishing destinations, which increases the risk of inter-shed transportation of the snail. In addition, the NZMS has also arrived in the San Francisco Bay area (see figure), the premier origin for visitors to the Reno / Tahoe area. This further exacerbates the TCWW's risk of contamination by the NZMS.

The TCWW is an important fishing destination. As documented in Table 1, these rivers attract an average of 16,000-17,000 anglers spending 151,000 visitation days per year. For 2001, this translated into 50% of the total number of fishing days on all rivers and streams in Nevada (see table). An invasion of the NZMS of this area has the potential to reduce both fish size and catch rates. This, in turn, would likely reduce angler visits, as is well documented in the economic literature (e.g. Morey et al., 1993, Adamowicz et al., 1994, Englin and Cameron, 1996).

The economic implications of reduced angling quality and visitation are twofold. First, to the extent that reduced quality decreases visitation days, the regional economy will experience a loss in revenue from fishing related activities. As reported in the National Survey on Fishing, Hunting, and Wildlife-Associated Recreation (U.S. Fish and Wildlife Service, 2001) in 2001 the average angler visiting a Nevada fishing destination spent close to \$50 / day in trip-related costs, the lion's share of which were likely incurred within the region surrounding the trip destination. By multiplying average annual visitation days by daily trip expenditures, one could alternatively claim that fishing in the TCWW constitutes a \$7.5 million industry to the local economy.

The second economic implication is somewhat subtler. Poorer fishing quality implies a reduction in recreational benefits an angler obtains on any given visitation day. In economic terms, this decrease in benefits is referred to as "welfare loss", or, alternatively, a decrease in consumer surplus. Consumer surplus (CS) is the economic value an angler experiences from a day on the water, or, alternatively, the maximum dollar amount he would have been willing to pay on top of actual trip costs to participate in the activity. In short, consumer surplus and economic welfare for a consumer are the analog to the notion of "profits" for a firm. Modern economic theory and econometric estimation tools allow the researcher to translate changes in recreation quality directly into dollar equivalent gains or losses in welfare. The field of Applied Economics that relates physical changes in natural resources to economic welfare changes to consumers is often referred to as Nonmarket Valuation (for an accessible introduction to this topic see e.g. Champ et al., 2003 ). The knowledge of welfare implications associated with different management strategies for a given resource aids decision makers in choosing the policy that maximizes net societal welfare, counting gains and losses to all relevant sub-segments of the underlying population of interest.

For freshwater fishing, for example, consumer surplus flowing from a day of fishing has been estimated at \$50-100, depending on the precise resource in question (salmon or trout fishing), and the econometric model used to produce these estimates (e.g. Englin and Cameron, 1996, Englin and Lambert, 1995, Englin et al., 1997). Conversely, estimates for the loss in welfare due to, say, a 50% reduction in catch rates for a variety of fishing experiences range from \$200 to \$500 per season and angler (Morey et

al., 1993, Breffle and Morey, 2000). These losses in welfare have to be added to economic losses to the local tourism and outfitting industry from reduced visitor spending when assessing the total economic impact of a degradation of a given fishery, whatever the cause may be. Given the invasive characteristics of the NZMS, it is very likely that these combined economic losses can be staggering, even in the short run. Aggregate figures from the existing literature can provide some indication of the magnitude of these losses. However, for more precise estimates of economic implications for a given watershed a survey of anglers that use this watershed is needed.

To our knowledge, this is proposed research is the *first economic study* related to the NZMS problem. Its results should provide useful decision input for resource managers beyond the TCW watershed.

### *Research Objectives*

The main field component of this research effort was the design and implementation of a combined mail / web survey of anglers who obtained a Nevada fishing license for the 2004 / 2005 season. This report summarizes the findings from this survey in descriptive form. Subsequent research will use the survey data to derive the economic effects of a change in fishing quality in the TCW system.

The survey was designed to provide the baseline data to address the following five main research objectives:

1. **Assess the level of awareness of anglers regarding the NZMS threat to Western waters.**  
This should aid managing agencies in determining the amount and type of outreach effort needed to achieve a given awareness target.
2. **Assess the risk of introduction of the NZMS to the TCWW through human vectors.**  
This was accomplished by asking respondents about all fishing trips they took in 2004/2005. The share of respondents that had visited currently contaminated areas will provide resource managers with a clearer understanding of contamination risk, which, in turn, should aid resource managers in devising a timeline for implementation of snail averting campaigns and policies.
3. **Assess the economic welfare generated by the TCWW under current conditions.**  
Each angler will be asked to report the number of fishing trips to various sections of the TCWW for both the 2004 and 2005 fishing seasons. This will allow for the estimation of economic welfare generated by each of these sections under baseline conditions.
4. **Assess the change in visitation behavior and in agency revenues.**  
Respondents will be presented with snail-averting policy scenarios at various river sections, such as stricter bag and bait regulations, and possible site closures. For each scenario, the survey will elicit the effect of these changes on anglers' trip behavior and their propensity to purchase an annual fishing license. This information should provide managers with a good perspective on the relative magnitude of economic costs associated with *averting vs. combating measures*.
5. **Collect information on "typical" per-trip expenditures from all respondents.**  
This will allow to relate findings from steps (3) and (4) to the economic impact on the regional tourism and outfitter industry, and thus provide further decision input to managers when weighing the pros and cons associated with specific snail-related strategies.

Table 1: Angler counts and visitation days for the TCW watershed, 1994-2002

Year	Truckee*		Carson**		Walker***		T,C,W Total		NV Rivers & Streams****	
	Anglers	Days	Anglers	Days	Anglers	Days				
2002	9,433	77,076	2235	19655	2,849	10,222	14,517	106,953		
2001	11,695	151,729	1837	14603	2,610	13,112	16,142	179,444	69,000	337,000
2000	12,605	173,207	3196	23704	4,526	20,692	20,327	217,603		
1999	12,406	138,031	3290	55656	5,215	29,149	20,911	222,836		
1998	9,970	107,901	2198	13967	4,351	17,384	16,519	139,252		
1997	11,022	121,145	2949	21373	4,379	20,483	18,350	163,001		
1996	9,524	95,624	3267	24334	4,055	20,243	16,846	140,201	102,000	560,000
1995	9,779	76,554	2825	26,601	1,996	12,015	14,600	115,170		
1994	7,810	62,793	1587	11,614	422	2,753	9,819	77,160		
Average:	10,472	111,562	2,598	23,501	3,378	16,228	16,448	151,291		

\*Source: Nevada Department of Wildlife Federal Aid Job Progress report, Truckee River, 1999 and 2003

\*\*Source: Nevada Department of Wildlife Federal Aid Job Progress report, Carson River, 1999 and 2003

\*\*\*Source: Nevada Department of Wildlife Federal Aid Job Progress report, Walker River, 1999 and 2003

(All figures are expanded from the 10% mail-in angler questionnaire)

\*\*\*\*1996 and 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, Economics & Statistics Administration



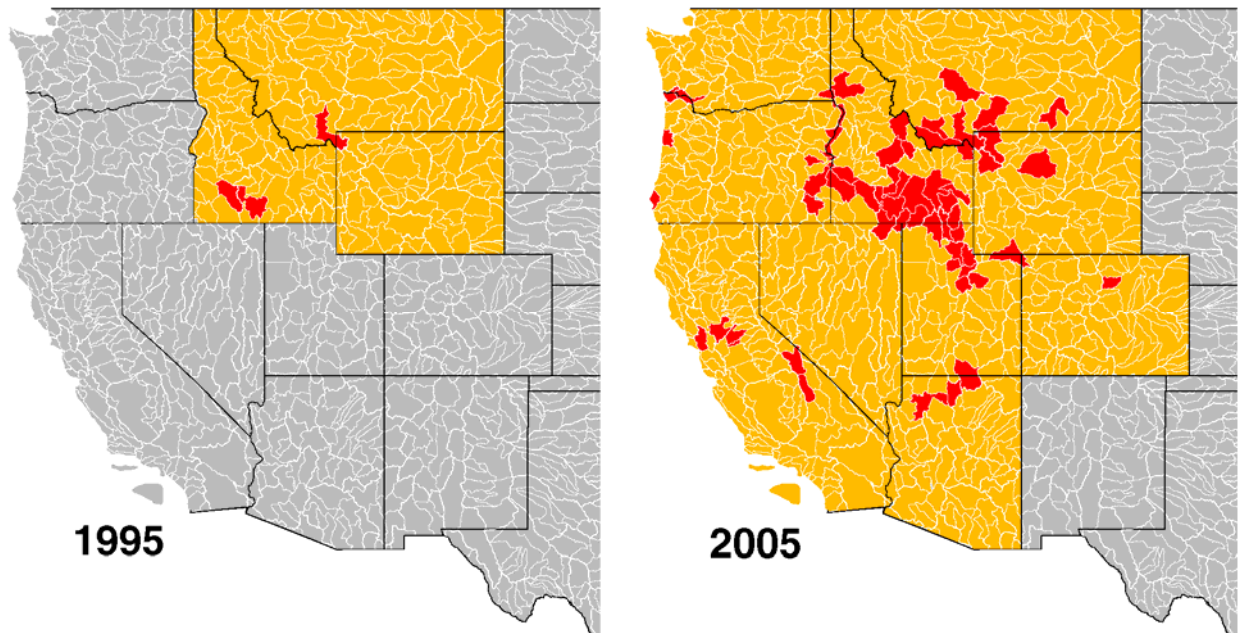
Table 2: Angler counts by origin (residence) for the 2002 season

Angler Origin	Truckee		Carson		Walker		All	
	Count	%	Count	%	Count	%	Count	%
Churchill County	112	1.3%	45	1.6%	215	4.7%	372	2.3%
Clark County	105	1.2%	0	0.0%	159	3.5%	264	1.6%
Douglas County	79	0.9%	1,199	41.7%	569	12.6%	1,847	11.4%
Elko County	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Esmeralda County	0	0.0%	0	0.0%	2	0.0%	2	0.0%
Eureka County	2	0.0%	0	0.0%	3	0.1%	5	0.0%
Humboldt County	17	0.2%	0	0.0%	0	0.0%	17	0.1%
Lander County	0	0.0%	0	0.0%	9	0.2%	9	0.1%
Lyon County	468	5.3%	303	10.5%	1,037	22.9%	1,808	11.2%
Mineral County	4	0.0%	0	0.0%	134	3.0%	138	0.9%
Nye County	2	0.0%	0	0.0%	17	0.4%	19	0.1%
Carson City	295	3.4%	988	34.4%	580	12.8%	1,863	11.5%
Pershing County	5	0.1%	0	0.0%	12	0.3%	17	0.1%
Storey County	0	0.0%	4	0.1%	4	0.1%	8	0.0%
Washoe County	6,877	78.4%	173	6.0%	602	13.3%	7,652	47.3%
White Pine County	0	0.0%	0	0.0%	0	0.0%	0	0.0%
<b>Total Nevada Anglers</b>	<b>7,966</b>	<b>90.8%</b>	<b>2,712</b>	<b>94.3%</b>	<b>3,343</b>	<b>73.8%</b>	<b>14,021</b>	<b>86.7%</b>
Arizona	30	0.3%	0	0.0%	8	0.2%	38	0.2%
California	469	5.3%	160	5.6%	1,072	23.7%	1,701	10.5%
Idaho	9	0.1%	0	0.0%	0	0.0%	9	0.1%
Utah	0	0.0%	0	0.0%	32	0.7%	32	0.2%
Other States	302	3.4%	4	0.1%	73	1.6%	379	2.3%
<b>Total Out-of-State</b>	<b>810</b>	<b>9.2%</b>	<b>164</b>	<b>5.7%</b>	<b>1,185</b>	<b>26.2%</b>	<b>2,159</b>	<b>13.3%</b>
<b>Grand total</b>	<b>8,776</b>	<b>100.0%</b>	<b>2,876</b>	<b>100.0%</b>	<b>4,528</b>	<b>100.0%</b>	<b>16,180</b>	<b>100.0%</b>

Source: Nevada Department of Wildlife

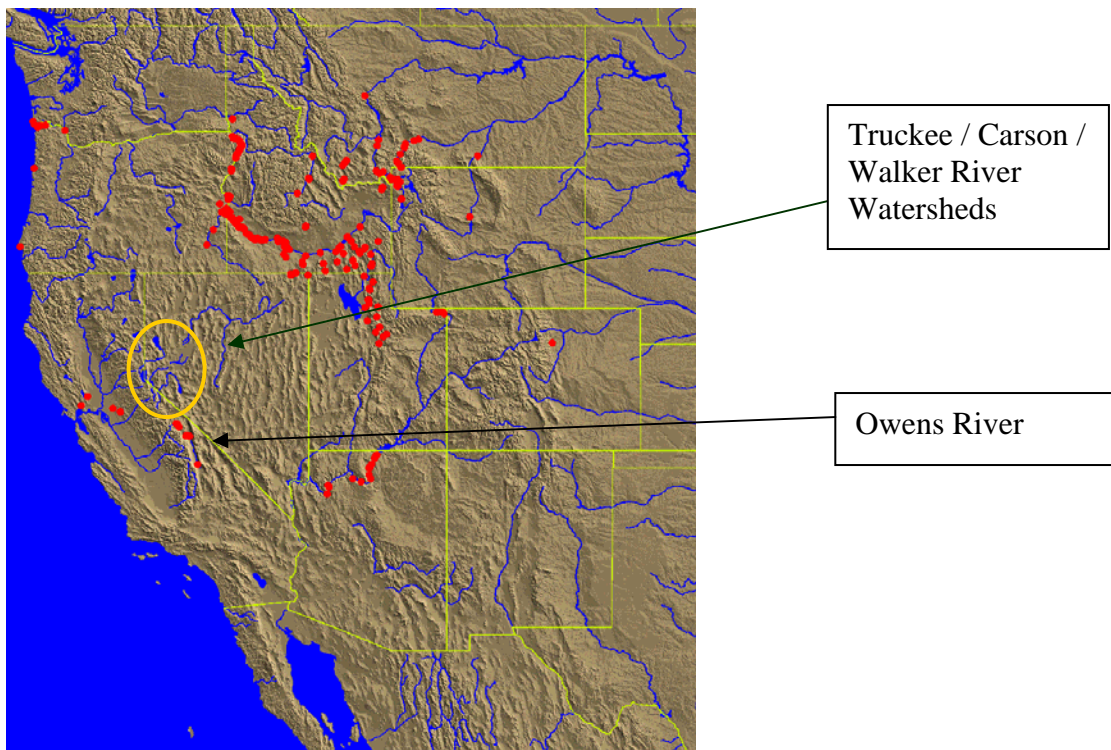
Figures expanded from the 2003 angler questionnaire survey

Figure 1: Spread of the NZMS over the last ten years



Source: Montana State University New Zealand mud snail web site  
<http://www.esg.montana.edu/aim/mollusca/nzms/status.html>

Figure 2: Documented occurrences of the NZMS in the Western U.S.



Source: Montana State University New Zealand mud snail web site  
<http://www.esg.montana.edu/aim/mollusca/nzms/status.html>

## **II) Survey Implementation and General Survey Statistics**

As can be seen from Table 2, Nevada residents comprise close to 90% of visitors to the TCWW. Since residency in Nevada for a given angler can be assumed to be highly correlated with the purchase of a Nevada license, the 2004/05 list of license holders available from the Nevada Department of Wildlife (NDOW) was considered an ideal sample frame for this research effort. Given the visitation counts captured in Table 2, the target population was further narrowed to include 2004 NV season license holders residing in Carson City, Churchill, Douglas, Lyon, and Washoe counties, NV, as well as all anglers residing in California. These groups constitute 80-90% of all anglers at the Truckee, Carson, and Walker rivers (TCW).

Each respondent was given the option to complete the survey online using the web version, or using a mailed hard copy of the questionnaire. The survey was implemented in five rounds during the period of November 2005 to February, 2006, following the "best science" methodology described in Dillman (2000).

The five rounds of contact and related sampling statistics are given in Table 3. As can be seen from the table, the initial round of questionnaires was mailed to 1800 anglers, randomly chosen from a sample frame of 28,331 2004 holders of a Nevada fishing license who reside in the target areas listed above. This target sample count was then adjusted for rounds 2 and 3 of the survey based on responses to previous rounds and attrition due to undeliverable addresses.

As shown in the table, response rates in terms of targeted anglers were in the 20 % range for the first two rounds and declined markedly to approximately 11% for round 3. This pattern is fairly common in multi-round mailings, as the latent propensity to participate amongst residual target anglers naturally declines with every round. The total percentage of undeliverable surveys is in the expected range of 10 – 20% for a relative transient area such as Reno / Sparks / Carson City. The overall response rate of close to 50% (based on deliverables) is satisfactory. Approximately 9% of respondents used the web version of the survey.

**Table 3: General survey statistics**

Activity	Launching period	target count	undeliverables		completed		
			count	% of target	count	% of target	% deliverables
Prenotice	Nov. 14, 2005	1800					
Round 1	Nov. 16-20, 2005	1800	209	11.6%	401	22.3%	25.2%
Thank you / reminder	Nov. 28, 2005	1800					
Round 2	Dec. 16-22	1190	43	3.6%	249	20.9%	21.7%
Round 3	Feb. 16, 17, 2006	898	32	3.6%	104	11.6%	12.0%
<b>Total</b>		<b>1800</b>	<b>284</b>	<b>15.8%</b>	<b>754</b>	<b>41.9%</b>	<b>49.7%</b>

## **IV) Survey Results**

### **1) Demographic Information**

Tables 1-9 illustrate the demographic composition of our sample. The sample can be described as predominantly male, with average age in the mid-50s. Over 60% of respondents have at least a high school level education. The bulk of the sample is located in the income bracket from \$40,000 - \$120,000. These demographic figures correspond closely to the overall statistics for the general population the Reno / Sparks area in Northern Nevada. Only 4.5% of respondents reside in California. This corresponds approximately to the visitation shares given in Table 2 for the Truckee and Carson rivers, but is clearly lower than the usual share of Californian visitors observed for the Walker river.

**Table 4: Angler composition by gender**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid female	115	15.3	16.5	16.5
male	580	76.9	83.5	100.0
Total	695	92.2	100.0	
Missing	59	7.8		
Total	754	100.0		

**Table 5: Angler composition by age**

	N	Minimum	Maximum	Mean	Std. Deviation
age	688	16	90	53.45	14.193
missing	66				

**Table 6: Angler composition by household type**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid household with children	232	30.8	33.3	33.3
single, no children	84	11.1	12.1	45.3
couple, no children	321	42.6	46.1	91.4
multiple adults, no children	60	8.0	8.6	100.0
Total	697	92.4	100.0	
Missing	57	7.6		
Total	754	100.0		

Table 7: Angler composition by education level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Elementary School	4	.5	.6	.6
	Jr. High School	8	1.1	1.2	1.8
	High School	244	32.4	35.6	37.4
	2 years of College	172	22.8	25.1	62.5
	4 years of College	121	16.0	17.7	80.1
	Graduate or professional school	136	18.0	19.9	100.0
	Total	685	90.8	100.0	
Missing		69	9.2		
Total		754	100.0		

Table 8: Angler composition by household income

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<\$20,000	37	4.9	6.1	6.1
	\$20,000 - \$39,999	88	11.7	14.4	20.5
	\$40,000 - \$59,999	134	17.8	22.0	42.5
	\$60,000 - \$79,999	104	13.8	17.1	59.6
	\$80,000 - \$99,999	82	10.9	13.5	73.1
	\$100,000 - \$119,999	74	9.8	12.2	85.2
	\$120,000 - \$139,999	29	3.8	4.8	90.0
	\$140,000 - \$159,999	17	2.3	2.8	92.8
	\$160,000 - \$179,999	8	1.1	1.3	94.1
	\$180,000 - \$199,999	5	.7	.8	94.9
	\$200,000 - \$224,999	10	1.3	1.6	96.6
	\$225,000 - \$249,999	3	.4	.5	97.0
	\$250,000 - \$274,999	7	.9	1.1	98.2
	\$275,000 - \$300,000	3	.4	.5	98.7
	>\$300,000	8	1.1	1.3	100.0
	Total	609	80.8	100.0	
Missing		145	19.2		
Total		754	100.0		

Table 9: Angler composition by State of residence

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NV residents	720	95.5	95.5	95.5
	CA residents	34	4.5	4.5	100.0
	Total	754	100.0	100.0	

## 2) General Fishing and License Information

By definition of our target population, all respondents held a seasonal fishing license for Nevada in 2004. As depicted in Table 10, about a third of anglers also held a California license in 2004. As shown in Table 11, the percentage of dual license holders declined slightly for 2005 (24.5%). Furthermore, close to 10% of our sample of respondents decided not to purchase a Nevada license for 2005.

A striking result produced by the survey is the substantial fishing experience, as measured in number of years of fishing, accumulated by the prototypical angler in our sample. As shown in Table 12, the average angler has fished for almost 40 years (median = 40). Approximately 20% of anglers are exclusive fly fishers, compared to 42% of spin-casters (table 13). Interestingly, close to 40% of anglers alternate between these two general techniques.

With respect to the NZMS threat, an important consideration is the wading behavior of river users. As Table 15 indicates, almost half of our sample uses wading at least occasionally when fishing. Based on this fishing preference, there is an ex ante relatively high probability of physical contact between wading gear and mud snails in case of a snail infestation of the TCW system.

As illustrated by Table 17, TCW anglers care mostly about "solitude", "scenery", and the ability to catch "any trout". In contrast, bait restrictions, bag limits, and "ease of access" are somewhat less important to the average angler. However, there is no site attribute that is not considered "important" or "very important" by at least 30% of respondents.

Table 10: Holding of CA license in 2004

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	465	61.7	65.7	65.7
	yes	243	32.2	34.3	100.0
	Total	708	93.9	100.0	
Missing	System	46	6.1		
Total		754	100.0		

Table 11: License mix for 2005

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NV license only	439	58.2	61.6	61.6
	CA license only	21	2.8	2.9	64.5
	Both licenses	185	24.5	25.9	90.5
	Neither of the two	68	9.0	9.5	100.0
	Total	713	94.6	100.0	
Missing	System	41	5.4		
Total		754	100.0		

Table 12: Fishing experience

	N	Minimum	Maximum	Mean	Std. Deviation
years of fishing	694	0	81	38.42	16.955
missing	60				

Table 13: Fishing techniques

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	fly fishing only	146	19.4	19.4	19.4
	spin casting only	317	42.0	42.0	61.4
	both techniques	291	38.6	38.6	100.0
	Total	754	100.0	100.0	

Table 14: Spin casting techniques

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	artificial lures only	100	13.3	16.6	16.6
	bait only	27	3.6	4.5	21.0
	artificial lures and bait	477	63.3	79.0	100.0
	Total	604	80.1	100.0	
Missing	System	150	19.9		
Total		754	100.0		

Table 15: Wading habits

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes, most of the time	157	20.8	22.4	22.4
	yes, sometimes	218	28.9	31.1	53.5
	rarely	212	28.1	30.2	83.7
	never	114	15.1	16.3	100.0
	Total	701	93.0	100.0	
Missing	System	53	7.0		
Total		754	100.0		

Table 16: Fish-keeping habits

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes, I keep most fish	252	33.4	35.9	35.9
	yes, occasionally	372	49.3	53.1	89.0
	never	77	10.2	11.0	100.0
	Total	701	93.0	100.0	
Missing	System	53	7.0		
Total		754	100.0		

Table 17: Importance of various fishing site attributes

	not important		somewhat important		important		very important		Total	
	Count	%	Count	%	Count	%	Count	%	Count	%
importance of solitude	45	6.6%	198	28.9%	257	37.6%	184	26.9%	684	100.0%
importance of easy access	190	27.6%	291	42.2%	144	20.9%	64	9.3%	689	100.0%
importance of scenery	62	9.2%	181	26.8%	273	40.4%	160	23.7%	676	100.0%
importance of catching any trout	59	8.7%	184	27.0%	292	42.8%	147	21.6%	682	100.0%
importance of catching large trout	77	11.3%	241	35.3%	225	33.0%	139	20.4%	682	100.0%
importance of catching wild trout	117	17.1%	228	33.3%	221	32.3%	118	17.3%	684	100.0%
importance of no bait restrictions	248	36.2%	220	32.1%	136	19.9%	81	11.8%	685	100.0%
importance of keeping trout = allowed	177	25.8%	186	27.1%	198	28.8%	126	18.3%	687	100.0%



### 3) Mud Snail Awareness and Containment

As shown in Table 18, a large share of anglers (close to 75%) were not aware of the NZMS threat prior to this survey. This casts doubt on the sufficiency and effectiveness of NZMS awareness campaigns in recent years, especially given the generally high level of fishing experience for our sample. Those who were aware of the snail received their information primarily through the media (Table 19). Less than a third of aware anglers listed signs posted outdoors as information source.

As indicated in Table 20, approximately 20% of aware anglers have not taken any snail containment measures in the past. Together with previously unaware anglers, this leaves a segment of  $525+35=560$  anglers, almost 80% of our sample, who in the past have not paid much attention to the NZMS problem when fishing. To make matters worse, this "unaware / no contain" group also constitutes close to 42% of anglers that have fished at already infested sites in the past two years, as indicated in Table 23. Overall, a total of 103 of respondents (approx. 14% of our sample) have fished at one or more of the contaminated waters listed in the survey in 2004 / 2005. In general, thus, the overall picture of mud snail awareness and containment for our sample is rather dismal, especially given the high propensity to wade mentioned above, and the non-trivial percentage of TCW anglers that have visited contaminated waters in the recent past.

On a brighter note, over 90% of previously unaware anglers are planning to use snail containment measures in the future, as shown in Table 21. Naturally, this is only a hypothetical statement. The actual implementation rate for such measures may be significantly lower.

Table 18: Previous awareness of the NZMS

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid no	525	69.6	74.7	74.7
yes	178	23.6	25.3	100.0
Total	703	93.2	100.0	
Missing	51	6.8		
Total	754	100.0		

Table 19: Sources of Information on the NZMS

	no		yes		Total	
	Count	%	Count	%	Count	%
media	71	39.9%	107	60.1%	178	100.0%
poster / flyer outdoors	128	71.9%	50	28.1%	178	100.0%
poster / flyer in store	148	83.1%	30	16.9%	178	100.0%
word to mouth	129	72.5%	49	27.5%	178	100.0%
Info source = other	165	92.7%	13	7.3%	178	100.0%

Table 20: Containment measures taken by previously aware anglers

	no		yes		Total	
	Count	%	Count	%	Count	%
avoid wading	115	64.6%	63	35.4%	178	100.0%
drying gear	104	58.4%	74	41.6%	178	100.0%
leave gear in sun	150	84.3%	28	15.7%	178	100.0%
soaking gear in solution	168	94.4%	10	5.6%	178	100.0%
freezing gear	176	98.9%	2	1.1%	178	100.0%
use designated gear	171	96.1%	7	3.9%	178	100.0%
no containment measure	143	80.3%	35	19.7%	178	100.0%

Table 21: Future use of containment measures by previously unaware anglers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	definitely yes	280	37.1	56.5	56.5
	probably yes	171	22.7	34.5	90.9
	probably not	35	4.6	7.1	98.0
	definitely not	10	1.3	2.0	100.0
	Total	496	65.8	100.0	
Missing		258	34.2		
Total		754	100.0		

Table 22: Fishing at *specific* risk sites in 2004/2005 by awareness / containment type

Type 1: Previously aware anglers that take containment measures

	no		yes		Total	
	Count	%	Count	%	Count	%
Snake River	135	94.4%	8	5.6%	143	100.0%
Utah rivers	137	95.8%	6	4.2%	143	100.0%
Owens River	116	81.1%	27	18.9%	143	100.0%
Yellowstone rivers	134	93.7%	9	6.3%	143	100.0%
Colorado River	136	95.1%	7	4.9%	143	100.0%

Type 2: Previously unaware anglers or anglers that were aware but don't contain

	no		yes		Total	
	Count	%	Count	%	Count	%
Snake River	544	97.1%	16	2.9%	560	100.0%
Utah rivers	553	98.8%	7	1.3%	560	100.0%
Owens River	539	96.3%	21	3.8%	560	100.0%
Yellowstone rivers	550	98.2%	10	1.8%	560	100.0%
Colorado River in	542	96.8%	18	3.2%	560	100.0%

Table 23: Fishing at any risk site in 2004 / 2005 by awareness / containment type

containment type	Fished at any risk site in 2004 / 2005			
	no		yes	
	Count	%	Count	%
Type 1: Previously aware anglers that take containment measures	500	83.3%	60	58.3%
Type 2: Previously unaware anglers or anglers that were aware but don't contain	100	16.7%	43	41.7%
Total	600	100.0%	103	100.0%

#### 4) Fishing History

To assess the potential economic implications for the TCW region of changes in fishing quality and fishing regulations as they may arise in case of a NZMS infestation, a clear understanding of current visitation behavior is needed. Accordingly, the collection of past trip information within and outside the system constituted an integral part of this survey effort.

As shown in Table 24, the anglers included in our sample took a total number of 4165 day trips to the twelve TCM segments (as specified in the questionnaire). This number decreased by approximately 20% to 3303 trips for 2005. To some extent, this decrease may be related to the abundant winter of 2004/2005 which produced strong run-offs for the three rivers that lasted well into early summer. This may have shortened the "usable" fishing season for many anglers. For both years, trips to the Truckee constituted the lion's share of visits (60%), with the Carson and Walker rivers receiving about equal shares of trips. For all three rivers, the general regulation sections (T4, C4, W4) received the relatively largest shares of visits. However, it should be noted that these sections are much longer than any other segments specified in the survey. Accordingly, these numbers should not be interpreted in the sense of visits per specific access site or visits per mile of river.

Table 25 translates these counts into per-person statistics. As shown in the last row of the table, the average angler took 5.52 day trips to the TCW system in 2004, compared to 4.38 trips in 2005. As expected given the total visitation figures in the previous table, the average number of day trips to the Truckee (3.36) is substantially higher than the corresponding figures for the Carson and Walker rivers. As illustrated in section 7 below, this is likely a direct result of the shorter travel distances associated with Truckee sites faced by the average angler. As indicated by the "median" columns, for any of the 12 river segments, there are at least 50% of anglers that did not visit that specific section of the TCW system in either season.

As can be seen from Tables 29 and 30, the number of day trips made to fishing sites outside the TCW system is very small (5-6% of all day trips) compared to trips within the system for our sample of anglers. This will alleviate trip-substitution concerns in the modeling of economic demand and welfare in subsequent analyses based on these data. In other words, the 12 river segments given in the survey comprise essentially the entire universe of fishing sites considered by the typical respondent, at least at baseline conditions.

In contrast, the ratio of overnight trips to destination within and outside the TCW system is much more evenly balanced, with about 300-320 total trips to TCW sites, and 180-230 total overnight trips to sites outside the system. Overall, the ratio of overnight trips to day trips is approximately 1/8.

Table 24: Visitation counts by river section and year

Section	2004			2005		
	visits	% of river	% system	visits	% of river	% system
T1	153	6.04%	3.67%	116	5.96%	3.51%
T2	182	7.18%	4.37%	126	6.47%	3.81%
T3	635	25.05%	15.25%	528	27.13%	15.99%
T4	1565	61.74%	37.58%	1176	60.43%	35.60%
<i>River total</i>	<i>2535</i>	<i>100.00%</i>	<i>60.86%</i>	<i>1946</i>	<i>100.00%</i>	<i>58.92%</i>
C1	156	21.61%	3.75%	126	19.24%	3.81%
C2	94	13.02%	2.26%	76	11.60%	2.30%
C3	95	13.16%	2.28%	75	11.45%	2.27%
C4	377	52.22%	9.05%	378	57.71%	11.44%
<i>River total</i>	<i>722</i>	<i>100.00%</i>	<i>17.33%</i>	<i>655</i>	<i>100.00%</i>	<i>19.83%</i>
W1	221	24.34%	5.31%	165	23.50%	5.00%
W2	137	15.09%	3.29%	139	19.80%	4.21%
W3	204	22.47%	4.90%	156	22.22%	4.72%
W4	346	38.11%	8.31%	242	34.47%	7.33%
<i>River total</i>	<i>908</i>	<i>100.00%</i>	<i>21.80%</i>	<i>702</i>	<i>100.00%</i>	<i>21.25%</i>
<i>System total</i>	<i>4165</i>		<i>100.00%</i>	<i>3303</i>		<i>100.00%</i>

Table 25: Per-person visitation statistics by river section and year

Section	2004				2005			
	Mean	Median	Max.	Std	Mean	Median	Max.	Std
T1	0.20	0.00	30.00	1.79	0.15	0.00	25.00	1.34
T2	0.24	0.00	20.00	1.44	0.17	0.00	15.00	1.09
T3	0.84	0.00	100.00	4.42	0.70	0.00	100.00	4.21
T4	2.08	0.00	250.00	11.82	1.56	0.00	150.00	7.75
<i>Truckee, all sections</i>	<i>3.36</i>	<i>0.00</i>	<i>250.00</i>	<i>14.14</i>	<i>2.58</i>	<i>0.00</i>	<i>200.00</i>	<i>10.76</i>
C1	0.21	0.00	10.00	0.97	0.17	0.00	20.00	1.10
C2	0.12	0.00	10.00	0.76	0.10	0.00	10.00	0.66
C3	0.13	0.00	20.00	0.95	0.10	0.00	25.00	1.03
C4	0.50	0.00	40.00	2.55	0.50	0.00	40.00	2.57
<i>Carson, all sections</i>	<i>0.96</i>	<i>0.00</i>	<i>40.00</i>	<i>3.33</i>	<i>0.87</i>	<i>0.00</i>	<i>40.00</i>	<i>3.40</i>
W1	0.29	0.00	23.00	1.69	0.22	0.00	20.00	1.55
W2	0.18	0.00	50.00	2.05	0.18	0.00	50.00	2.14
W3	0.27	0.00	20.00	1.35	0.21	0.00	15.00	1.14
W4	0.46	0.00	20.00	1.59	0.32	0.00	12.00	1.21
<i>Walker, all sections</i>	<i>1.20</i>	<i>0.00</i>	<i>85.00</i>	<i>4.60</i>	<i>0.93</i>	<i>0.00</i>	<i>85.00</i>	<i>4.33</i>
<i>Entire System</i>	<i>5.52</i>	<i>0.50</i>	<i>250.00</i>	<i>15.63</i>	<i>4.38</i>	<i>0.00</i>	<i>200.00</i>	<i>12.75</i>

Table 26: Preferred segment of section T4 (if fished in 2004 / 2005)

River Segment	Frequency	Percent
Verdi to West McCarran	102	57.0
Urban Reno / Sparks	30	16.8
Sparks to Derby	31	17.3
Below Derby	16	8.9
Total	179	100.0

Table 27: Preferred segment of section C4 (if fished in 2004 / 2005)

River Segment	Frequency	Percent
Stateline to Gardnerville	12	41.4
Urban Minden / Gardnerville	2	6.9
Minden to Dayton	9	31.0
Below Dayton	6	20.7
Total	29	100.0

Table 28: Preferred segment of section W4 (if fished in 2004 / 2005)

River Segment	Frequency	Percent
Valid     The Elbow	37	43.5
Elbow to W. Walker	30	35.3
Below W. Walker	18	21.2
Total	85	100.0

Table 29: Per-person visitation statistics for overnight trips and trips outside the TCW system

Trip type	2004				2005			
	Mean	Median	Max	Std	Mean	Median	Max	Std
Overnight trips to TCW system	0.43	0.00	15.00	1.46	0.39	0.00	40.00	1.99
Day trips to other sites in CA / NV	0.35	0.00	65.00	2.53	0.27	0.00	115.00	3.61
Overnight trips to other sites in CA / NV	0.31	0.00	90.00	3.07	0.23	0.00	140.00	4.15

Table 30: Total counts for day trips and overnight trips within and outside the TCW system

	2004		2005	
	trips	% of total	trips	% of total
Day trips to TCW system	4165	94.10%	3303	94.26%
Day trips to other sites in CA / NV	261	5.90%	201	5.74%
Total day trips	4426	100.00%	3504	100.00%
Overnight trips to TCW system	321	58.15%	291	62.99%
Overnight trips to other sites in CA / NV	231	41.85%	171	37.01%
Total overnight trips	552	100.00%	462	100.00%

## 5) Fishing Decisions under Hypothetical Policy Changes

The advent of the NZMS may force resource managers to impose stricter lure and bag regulations or even site closures to (i) alleviate angler pressure on game fish, given the added pressure on fish's food sources through the snail, and (ii) to reduce or avoid angler / snail contact and thus curb a further expansion of the invader.<sup>1</sup>

We selected the three Nevada segments with currently general lure / size / bag regulations (T4, C4 and W4) for the hypothetical implementation of a "catch and release" rule. We asked anglers how this change in fishing regulation would affect their propensity to purchase a NV season license and their trip behavior to the specific sites. The results for these questions are summarized in Tables 31 – 36.

These results are very similar for all three segments. In each case, approximately 55-65% of respondents indicated that such a regulation change would not affect their license purchase or trip decisions. As expected given the non-trivial share of anglers that currently practice catch & release (Table 16), a small share of anglers (2-5%) would even be more likely to purchase a license and take trips to the newly regulated segment. This is likely a result of expected lower congestion levels for these sites under a catch & release rule. About 10-15% of respondents indicated that they would be less likely to purchase a NV license under the new regulation, and a sizeable share of 5-6% of anglers stated that they would definitely not purchase a NV license under the stipulated scenario. Similarly, approximately 14 – 15 % of respondents would not take any trips to the regulated segment under a catch & release rule.

In other words, an implementation of "catch & release" at *any one* of these three sections could lead to a loss of 5-10% of seasonal license sales. At the same time, such a policy could have a measurable "pressure alleviation" effect with a participation reduction of about 15%. Naturally, the actual expected reduction in trips for each stipulated river segment depends on current baseline use by the respondents that would stop visiting these sites. These figures will be derived in subsequent analyses.

For hypothetical seasonal site closures we considered the Nevada segments T3, T4, and W3. This mix provides for some variety in current fishing regulations and access. Specifically, as explained in the survey pamphlet (Appendix A), T4 is the general regulation section on the Truckee, T3 is the Nevada "trophy section" of the Truckee with lure, size, and bag restrictions, and W3 is Nevada's the "blue ribbon" section on the Walker river with a strict catch & release rule.

For segments T3 and W3, the effect of a closure is similar to the effect of a catch & release rule for sections T4, C4, and W4, with approximately 4-5% of anglers indicating that they would no longer purchase a NV license and 12-14% stating a reduced propensity to purchase a NV license should any one of these sections be closed for the season (Tables 37 and 41). These figures are somewhat more pronounced for section T4, with a drop-out rate of almost 9% and a reduced purchase propensity rate of 19% (Table 39).

This pattern is similar when anglers' reaction to site closures is measured in terms of changed visitation behavior. As shown in Tables 38 and 42, about 52-53% of anglers state that their number of *overall* fishing trips would not be affected under closure of either section T3 or W3. In contrast, this "zero-effect" percentage decreases to 42% for a closure of segment T4 (Table T40). Also, close to 21% of anglers stated that they would reduce their overall number of fishing trips should T4 be closed in a given season, compared to 10-14% of fewer-trip responses associated with closures of segments T3 or W3. Approximately 10-15% of anglers would compensate for the segment closures primarily with additional trips to sites outside the TCW system (tables 38, 40, 42).

---

<sup>1</sup> We also considered stipulating a hypothetical ban on wading as a possible snail-combating strategy. However, this scenario was considered as too controversial and difficult to implement from a legal perspective by local resource managers and thus discarded.

Table 31: Effect of catch &amp; release for section T4 on the purchase of a NV license

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid no effect	496	65.8	75.2	75.2
purchase more likely	30	4.0	4.5	79.7
purchase less likely	95	12.6	14.4	94.1
definitely no purchase	39	5.2	5.9	100.0
Total	660	87.5	100.0	
Missing	94	12.5		
Total	754	100.0		

Table 32: Effect of catch &amp; release for section T4 on trips to T4

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid no effect	426	56.5	65.4	65.4
likely take more trips	23	3.1	3.5	69.0
likely take fewer trips	96	12.7	14.7	83.7
no trips	106	14.1	16.3	100.0
Total	651	86.3	100.0	
Missing	103	13.7		
Total	754	100.0		

Table 33: Effect of catch &amp; release for section C4 on the purchase of a NV license

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid no effect	507	67.2	78.1	78.1
purchase more likely	24	3.2	3.7	81.8
purchase less likely	76	10.1	11.7	93.5
definitely no purchase	42	5.6	6.5	100.0
Total	649	86.1	100.0	
Missing	105	13.9		
Total	754	100.0		

Table 34: Effect of catch &amp; release for section C4 on trips to C4

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid no effect	432	57.3	67.0	67.0
likely take more trips	22	2.9	3.4	70.4
likely take fewer trips	85	11.3	13.2	83.6
no trips	106	14.1	16.4	100.0
Total	645	85.5	100.0	
Missing	109	14.5		
Total	754	100.0		

Table 35: Effect of catch &amp; release for section W4 on the purchase of a NV license

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid no effect	495	65.6	76.4	76.4
purchase more likely	24	3.2	3.7	80.1
purchase less likely	81	10.7	12.5	92.6
definitely no purchase	48	6.4	7.4	100.0
Total	648	85.9	100.0	
Missing	106	14.1		
Total	754	100.0		

Table 36: Effect of catch &amp; release for section W4 on trips to W4

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid no effect	420	55.7	65.6	65.6
likely take more trips	21	2.8	3.3	68.9
likely take fewer trips	91	12.1	14.2	83.1
no trips	108	14.3	16.9	100.0
Total	640	84.9	100.0	
Missing	114	15.1		
Total	754	100.0		

Table 37: Effect of closure of section T3 on the purchase of a NV license

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid no effect	509	67.5	77.4	77.4
purchase less likely	110	14.6	16.7	94.1
definitely no purchase	39	5.2	5.9	100.0
Total	658	87.3	100.0	
Missing System	96	12.7		
Total	754	100.0		

Table 38: Effect of closure of section T3 on overall trips

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid no effect	399	52.9	61.6	61.6
take fewer trips overall	89	11.8	13.7	75.3
take more trips to other TCW sections	83	11.0	12.8	88.1
take more trips outside TCW system	77	10.2	11.9	100.0
Total	648	85.9	100.0	
Missing	106	14.1		
Total	754	100.0		



Table 39: Effect of closure of section T4 on the purchase of a NV license

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid no effect	448	59.4	68.3	68.3
purchase less likely	143	19.0	21.8	90.1
definitely no purchase	65	8.6	9.9	100.0
Total	656	87.0	100.0	
Missing	98	13.0		
Total	754	100.0		

Table 40: Effect of closure of section T4 on overall trips

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid no effect	316	41.9	48.8	48.8
take fewer trips overall	155	20.6	23.9	72.7
take more trips to other TCW sections	79	10.5	12.2	84.9
take more trips outside TCW system	98	13.0	15.1	100.0
Total	648	85.9	100.0	
Missing	106	14.1		
Total	754	100.0		

Table 41: Effect of closure of section W3 on the purchase of a NV license

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid no effect	526	69.8	80.7	80.7
purchase less likely	92	12.2	14.1	94.8
definitely no purchase	34	4.5	5.2	100.0
Total	652	86.5	100.0	
Missing	102	13.5		
Total	754	100.0		

Table 42: Effect of closure of section W3 on overall trips

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid no effect	397	52.7	61.3	61.3
take fewer trips overall	103	13.7	15.9	77.2
take more trips to other TCW sections	73	9.7	11.3	88.4
take more trips outside TCW system	75	9.9	11.6	100.0
Total	648	85.9	100.0	
Missing	106	14.1		
Total	754	100.0		

## 5) Trip Expenditures

To assess the impact of changes in visitation behavior in reaction to a deterioration of fishing quality in the TCW system on the regional economy, the survey also collected information on typical expenditures for day and overnight fishing trips from each respondent. This information is summarized in Tables 43 and 44. As can be seen from Table 43, the typical angler spends about \$62 per day trip on food, gas, and trip-related fishing items. This figure is substantially larger for California residents (\$105) than for Nevada anglers (\$60), with the difference mainly driven by higher gasoline expenses related to generally longer driving distances to reach the TCW system (see also section 7). In fact, for both residency types gasoline expenditures constitute the largest share of overall expenses, followed by outlays for food and beverages, and day-trip related fishing gear<sup>2</sup>.

While somewhat less pronounced in relative terms this difference across residency persists for expenditures related to overnight trips, as can be seen from Table 44. Specifically, the average California resident spends about \$205 on an overnight fishing trip, compared to \$153 spent by the average Nevada angler. Naturally, as for day trip expenditures, these figures have to be interpreted with caution given the small sub-sample of respondents who reside in California.

Overall, though, these findings clearly indicate that per-trip expenditures are of a magnitude that could easily translate into sizable losses to the local economy if anglers reduce their overall number of trips to the TCW system in reaction to deteriorated fishing conditions. These potential changes in trip demand will be examined more closely in subsequent analyses.

Table 43: Day trip expenditures by residency

Nevada Residents					
expenditure item	Mean	Median	Max	Std	n
food/beverages	21.51	20.00	300.00	23.33	549
gasoline	30.11	25.00	400.00	27.64	591
tackle / bait / lures	12.22	10.00	100.00	9.14	546
<i>all</i>	<i>60.15</i>	<i>50.00</i>	<i>550.00</i>	<i>48.38</i>	<i>603</i>
California Residents					
expenditure item	Mean	Median	Max	Std	n
food/beverages	31.31	20.00	150.00	31.54	26
gasoline	57.52	40.00	150.00	41.91	27
tackle / bait / lures	17.92	10.00	50.00	14.83	26
<i>all</i>	<i>104.93</i>	<i>90.00</i>	<i>300.00</i>	<i>69.83</i>	<i>27</i>
All					
expenditure item	Mean	Median	Max	Std	n
food/beverages	21.95	20.00	300.00	23.81	575
gasoline	31.30	25.00	400.00	28.91	618
tackle / bait / lures	12.48	10.00	100.00	9.53	572
<i>all</i>	<i>62.07</i>	<i>50.00</i>	<i>550.00</i>	<i>50.24</i>	<i>630</i>

n=valid observations

<sup>2</sup> Expenditures on general fishing gear, such as rod, reel, waders etc. were not considered in this analysis, since such outlays have more of a fixed-cost character and cannot be clearly allocated to any individual fishing trip.

Table 44: Overnight trip expenditures by residency

Nevada Residents					
expenditure item	Mean	Median	Max	Std	n
accommodation	45.27	35.00	500.00	52.02	370
food/beverages	47.03	40.00	300.00	41.09	460
gasoline	57.03	50.00	300.00	42.25	475
tackle / bait / lures	19.37	20.00	100.00	14.68	446
<i>all</i>	<i>152.50</i>	<i>130.00</i>	<i>875.00</i>	<i>110.90</i>	<i>486</i>
California Residents					
expenditure item	Mean	Median	Max	Std	n
accommodation	51.30	25.00	200.00	55.00	23
food/beverages	50.50	40.00	150.00	31.50	26
gasoline	82.40	80.00	180.00	46.46	25
tackle / bait / lures	30.96	20.00	100.00	27.43	25
<i>all</i>	<i>204.88</i>	<i>220.00</i>	<i>450.00</i>	<i>107.81</i>	<i>26</i>
All					
expenditure item	Mean	Median	Max	Std	n
accommodation	45.62	35.00	500.00	52.14	393
food/beverages	47.21	40.00	300.00	40.62	486
gasoline	58.30	50.00	300.00	42.78	500
tackle / bait / lures	19.99	20.00	100.00	15.79	471
<i>all</i>	<i>155.16</i>	<i>132.50</i>	<i>875.00</i>	<i>111.24</i>	<i>512</i>

n=valid observations

## 7) Travel Distances

Travel distances for each respondent to each of the river segments were computed as follows: (i) Each survey respondent provided the zip code for their primary residence. Using U.S. Census zip code polygons, we first created a centroid for each zip code reported in the survey. (ii) To identify plausible travel routes, we used the U.S. Census Tiger Line files for both the Nevada and California road networks. These networks comprised all primary and secondary roads in both states. (iii) We geo-coded the anchor points for each river segment by selecting the nearest road access point to each section. (iv) Using Arcview Network Analyst we then wrote a script to identify the shortest road distance from every zip code to each anchor point for all river segments.<sup>3</sup> An overview of ZIP code centroids and river anchor points for our sample is given in Figure 3.

Table 45 summarizes travel distances to each of the 12 TCW sections. Since sections T4, C4, and W4 are too long to allow for a well defined anchor point for the measurement of distances, they are divided into shorter sub-segments A-D (A-C for the Walker River) as described in the questionnaire to allow for a more meaningful derivation of travel distances. As for expenditures, the information on travel distances is presented for the entire sample and by angler residency.

As can be seen from the table, the average California resident has to travel five to six times further than the typical Nevada resident to reach any site in the TCW system. Naturally, it is likely that California residents that face distances of several hundred miles will not take any day trips to the TCW system, but instead visit the system for a prolonged period of time. The average Nevada angler has to travel approximately 40-70 miles to reach any of the Truckee sites, 50-70 miles to visit any of the Carson segments, and 60-100 miles to fish at any of the Walker sections. Since Nevada residents constitute 95% of the overall sample of respondents these average distances are similar for the sample-at-large.

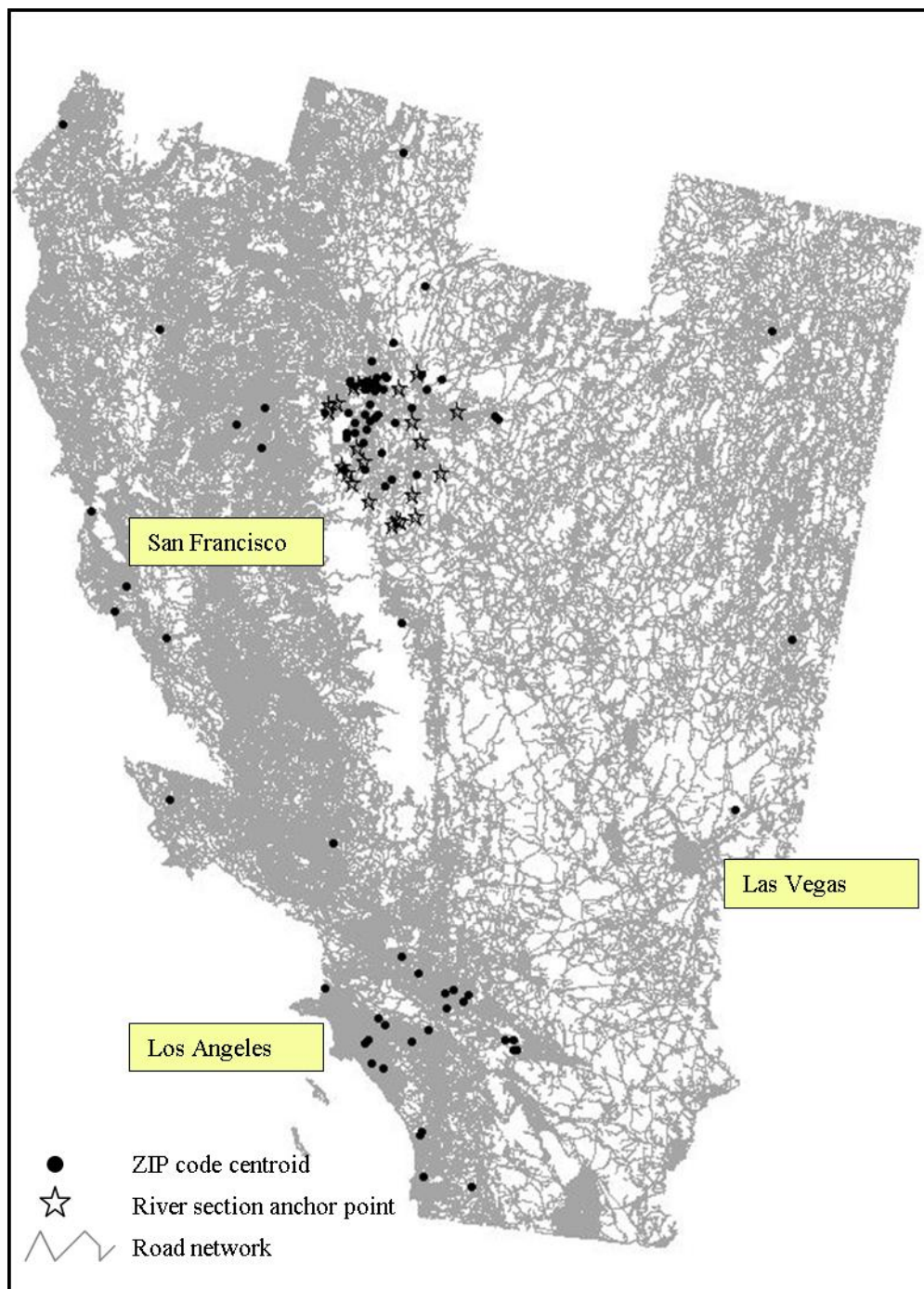
---

<sup>3</sup> It should be noted that this "shortest distance" approach does not necessarily imply "shortest travel time", since it is possible that the shortest road distance may not always be the fastest approach to a given site. Therefore, the shortest route may not always be the one chosen for a given angler-site combination.

Table 45: Travel distances by residency (one-way, miles)

Section	NV Residents (720 obs.)					CA Residents (34 obs.)					All				
	Mean	Med.	Min.	Max.	Std	Mean	Med.	Min	Max.	Std	Mean	Med.	Min	Max.	Std
T1	71.6	53.9	19.3	450.3	44.4	333.5	410.0	5.1	568.2	172.0	83.4	54.0	5.1	568.2	78.3
T2	66.9	51.0	17.3	437.6	42.4	337.3	414.6	13.2	572.7	172.5	79.1	51.5	13.2	572.7	78.6
T3	50.5	37.6	5.1	425.6	44.0	338.7	409.3	32.9	567.5	166.4	63.5	43.8	5.1	567.5	81.5
T4, A	44.9	34.6	4.4	418.8	43.4	336.1	402.9	38.0	561.1	162.8	58.0	38.7	4.4	561.1	81.4
T4, B	38.4	29.6	0.3	404.3	40.9	332.9	391.3	45.6	549.4	154.5	51.7	32.3	0.3	549.4	79.9
T4, C	46.8	34.6	9.8	402.1	37.6	344.5	399.3	62.3	557.5	151.0	60.3	34.6	9.8	557.5	78.5
T4, D	56.2	44.4	14.2	390.5	33.8	319.4	362.7	63.7	520.9	136.8	68.1	45.0	14.2	520.9	70.0
<i>Truckee, all sections</i>	53.6	39.6	21.2	418.5	40.0	334.6	398.6	40.5	556.8	159.1	66.3	45.8	21.2	556.8	77.7
C1	70.2	62.5	25.2	410.2	42.0	307.1	370.8	8.5	523.6	152.9	80.9	62.5	8.5	523.6	71.6
C2	73.6	68.5	19.0	394.8	40.2	301.7	363.8	11.3	508.2	142.6	83.9	68.7	11.3	508.2	68.4
C3	69.5	60.9	22.3	402.4	42.0	304.3	370.6	3.7	515.8	147.9	80.1	61.1	3.7	515.8	70.8
C4, A	59.8	52.8	6.0	394.5	41.8	303.9	364.2	19.8	508.5	142.1	70.8	53.7	6.0	508.5	71.6
C4, B	54.1	45.1	8.4	403.8	41.6	307.5	369.5	18.0	517.8	147.6	65.5	45.5	8.4	517.8	73.3
C4, C	50.0	44.7	9.5	379.3	28.6	324.8	374.7	60.3	524.4	137.8	62.4	44.7	9.5	524.4	69.8
C4, D	63.5	62.2	26.5	364.0	22.6	330.7	387.8	57.3	536.1	142.4	75.6	63.6	26.5	536.1	66.7
<i>Carson, all sections</i>	63.0	56.1	29.9	392.7	34.5	311.4	373.2	26.4	519.2	144.4	74.2	56.1	26.4	519.2	68.7
W1	80.1	78.0	29.7	350.5	31.8	286.5	317.6	61.6	461.9	114.5	89.4	78.0	29.7	461.9	58.1
W2	100.5	108.6	33.5	354.3	31.9	289.8	313.4	65.6	457.9	108.1	109.0	108.6	33.5	457.9	55.0
W3	93.6	101.1	26.0	345.4	31.2	294.0	320.7	60.7	465.0	111.0	102.6	101.1	26.0	465.0	56.6
W4	94.4	103.8	28.7	342.7	31.1	292.3	317.9	63.4	462.2	108.6	103.3	103.8	28.7	462.2	56.0
W4, B	86.0	93.2	25.8	348.3	29.9	300.6	326.8	71.5	471.2	110.4	95.6	93.3	25.8	471.2	58.1
W4, C	62.7	57.7	24.7	361.6	26.6	328.5	374.1	69.2	518.4	128.7	74.7	59.7	24.7	518.4	66.7
<i>Walker, all sections</i>	86.2	90.2	32.9	350.4	29.0	298.6	328.4	66.2	472.8	113.2	95.8	90.3	32.9	472.8	57.5
Entire System	67.6	57.6	48.2	387.2	30.9	314.9	371.9	54.1	516.2	137.6	78.7	57.8	48.2	516.2	66.2

Figure 3: Respondent origins and fishing destinations in the TCW system



## **V) Concluding Remarks and Next Steps**

This survey collected useful information on anglers' fishing preferences and choices within the Truckee / Carson / Walker watershed in Northern Nevada. The survey also shed light on the current status of anglers' awareness of the NZMS threat, and, given such awareness, the containment methods they use to prevent a further spread of the snail.

The results indicate that the TCW system is an important recreational fishery, judged both by the number of angler visits and angler expenditures flowing to the regional economy. As survey results indicate, the anglers represented in our sample took between 3000 and 4000 day trips to the TCW in 2004 and 2005. Extrapolating these figures to the entire population of Nevada license holders (approximately 28,000 in 2004) yields an estimated total number of 110,000 to 140,000 seasonal day trips to the three-river system. These figures correspond very closely to the visits estimated for the period 1994-2002 captured in Table 1, which strengthens our confidence in the representativeness of our sample with respect to the general population of Nevada license holders. Similarly, the total number of overnight trips to TCW fishing sites can be derived to lie between 10,000 and 12,000 visits per season.

The average angler spends about \$60 on a day trip and \$150 on an overnight trip. This translates into total population expenditures of \$8-10 million on trips to the TCW system per season. While slightly higher, this bracket is definitely within the "ballpark" of hypothesized annual expenditures made in the introductory section of this report.

With respect to NZMS awareness and containment, we find that much needs to be done to increase awareness levels of the general population of anglers, and to create incentives for anglers to take snail-averting measures. For our sample, we find that close to 80% of anglers were either unaware of the NZMS threat or were aware and did not take any containment measures. With respect to the risk of a mud snail infestation of the TCW system, this finding of low awareness / containment is exacerbated by the facts that close to 15% of our sample fished at infested waters in 2004 / 2005, and almost half of the respondents indicated a preference for wading while fishing.

As anglers' responses to our hypothetical policy scenarios indicate, waiting for the snail to arrive at the TCW system before taking combating measures may be costly – both in terms of reduced license sales and reduced trips to the system, with associated losses in revenue to the local economy.

The exact derivation of the economic implications of a deterioration of fishing quality at the three rivers is subject to the next step of this research. We will combine data on trip choices and angler characteristics collected through this survey with information on fishing quality and other physical attributes of the 12 river segments to estimate an economic demand model for the TCW fisheries. By setting explanatory quality variables such as fish / mile and average fish size to levels that may be expected in case of a snail infestation, and by varying regulatory attributes such lure / size/ bag restrictions and site closures, this model will allow for the prediction of trips and economic welfare (consumer surplus) for a variety of hypothetical "snail scenarios". In turn, the estimated reduction in predicted trips corresponding to a specific infestation scenario will allow for the computation of estimated losses in fishing trip-related revenues to the wider region.

## References

- Adamowicz, W., J. Louviere, and M. Williams. 1994. "Combining Revealed and Stated Preference Methods for Valuing Environmental Amenities." *Journal of Environmental Economics and Management* 26 (3) (May): 271-292.
- Breffe, W. S., and E. R. Morey. 2000. "Investigating Preference Heterogeneity in a Repeated Discrete-Choice Recreation Demand Model of Atlantic Salmon Fishing." *Marine Resource Economics* 15 (1) (Spring): 1-20.
- Cada, C. A., J. Smith, and B. Kerans. 2003. "What About the Fish?" A.-. Paper presented at the 3rd conference on Potamopyrgus antipodarum in the Western USA, Montana State University, Bozeman MT 59717,
- Cada, C. A. "Interactions between the Invasive New Zealand Mud Snail, Potamopyrgus Antipodarum, Baetid Mayflies, and Fish Predators." Master's Thesis, Montana State University, 2004.
- Champ, P. A., K. J. Boyle, and T. C. Brown (2003) A Primer on Nonmarket Valuation, ed. I. J. Bateman. Dordrecht / Boston / London, Kluwer Academic Publishers.
- Colorado Department of Wildlife (2005) Aquatic Hitchhikers,  
<http://wildlife.state.co.us/aquatic/nuisances/hitchhikers/NewZealandMudsnail.asp>
- Cutter, R. "Slate Wipers." *Fly Fisherman*, September 2004, 20-23.
- Department of Ecology, Montana State University (2005) New Zealand Mudsnails in the Western USA,  
<http://www.esg.montana.edu/aim/mollusca/nzms>.
- Dillman, D. A. 2000. *Mail and Internet Surveys - the Tailored Design Method*. John Wiley & Sons, Inc.
- Englin, J., and T. A. Cameron. 1996. "Augmenting Travel Cost Models with Contingent Behavior Data." *Environmental and Resource Economics* 7 (2) (March): 133-147.
- Englin, J., and D. Lambert. 1995. "Measuring Angling Quality in Count Data Models of Recreational Fishing." *Environmental and Resource Economics* 6 (4) (December): 389-399.
- Englin, J., D. Lambert, and W. D. Shaw. 1997. "A Structural Equations Approach to Modeling Consumptive Recreation Demand." *Journal of Environmental Economics and Management* 33 (1) (May): 33-43.
- Hall, R. O. Jr., J. L. Tank, and M. F. Dybdahl. 2003. "Exotic Snails Dominate Nitrogen and Carbon Cycling in a Highly Productive Stream." *Frontiers in Ecology and the Environment* 1 (8): 407-411.
- Kerans, B. L., et al. 2005. "Potamopyrgus Antipodarum: Distribution, Density, and Effects on Native Macroinvertebrate Assemblages in the Greater Yellowstone Ecosystem." *Journal of the North American Benthological Society* 24 (1): 123-138.
- Morey, E. R., R. D. Rowe, and M. Watson. 1993. "A Repeated Nested-Logit Model of Atlantic Salmon Fishing." *American Journal of Agricultural Economics* 75 (3) (August): 578-592.



- Richards, D. C. 2002. "The New Zealand Mud Snail Invades the Western United States." *Aquatic Nuisance Species Digest* 4 (4) (February): 42-44.
- U.S. Fish and Wildlife Service (2001). 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation / Nevada.
- Staton, L., B. MacConnel, B. Kerans, C. Hudson, 2003. "Assessment of New Zealand Mud Snail *Potamopyrgus Antipodarum* as a Potential Fish Parasite Vector." A.-. Paper presented at the 3rd conference on *Potamopyrgus antipodarum* in the Western USA, Montana State University, Bozeman MT 59717,
- Yellowstone National Park Service (2003) New Zealand Mud Snail, Baseline Distribution and Monitoring Study, <http://www.nps.gov/yell/planvisit/todo/fishing/mudsnail.htm>.

Appendix A: Survey Questionnaire

# Your Fishing Choices on the Truckee, Carson, and Walker Rivers and the Threat of the New Zealand Mud Snail

A survey conducted by the  
Department of Resource Economics, University of Nevada, Reno  
in collaboration with the  
Nevada Department of Wildlife

For any questions please contact  
Prof. Klaus Moeltner  
Phone: (775) 784-4803  
e-mail: moeltner@unr.edu

**PLEASE NOTE:** If you prefer, you can complete a **web version of this survey** online by going to the following web site: [www.ag.unr/mudsnail](http://www.ag.unr/mudsnail)

Simply log on using the following password (please use capital letters): **[insert survey id here]**

Mail and internet survey versions are identical in content. Please do **not** complete both!

If you decide to take the **web version** of this survey, you can discard this questionnaire and the enclosed return envelope. If you decide to take the **mail version** of this survey, please continue.

## ➤ Background Information:



NZMS on a match –  
photo courtesy of  
Ralph Cutter

The New Zealand Mud Snail (NZMS) is an invasive species that has become established over the last two decades in numerous rivers and lakes throughout the Western United States. It was first discovered in Idaho in the 1980s, and has since rapidly spread to other watersheds in ten Western States, including Yellowstone National Park. *Since the snail can survive in wet fishing gear for prolonged periods of time, spread through humans is the most common form of the snail's geographic expansion.* Once introduced into a water system the NZMS can spread very quickly and cover large segments of a river or lakebed within short periods of time. The snail competes for space and nutrients with aquatic insects and other traditional food sources of game fish such as trout. As a result, fishing quality in infested waters can deteriorate significantly. To date, there are no safe methods to control or exterminate the snail once it has become established. However, spread of the snail can be prevented through avoidance of wading or treatment of fishing gear.

While the NZMS has not yet been found in the Truckee / Carson / Walker (TCW) river system, it has been discovered in nearby waters, such as the Lower Owens River near Bishop, CA, and in California's Western Sierra foothills and the Northern Bay area. To better assess the risk and economic consequences of a potential NZMS contamination of our local waters it is extremely important for researchers and fishery managers to know more about anglers' awareness of the NZMS problem, and anglers' fishing choices in case of a loss in fishing quality and / or change in fishery management as a result of a mud snail infestation.

By completing this survey, you will provide essential information on these issues and thus help us to protect our waters against this potentially very destructive invasive species. **Your answers are strictly confidential and will be used for research purposes only.**

➤ Part I: General Fishing and License Information:

Q1. Approximately how many years have you been fishing?

\_\_\_\_\_ years

Q2. Do you use **fly fishing** on some or all of your trips?

☐ Yes ☐ No

Q3. Do you use **spin casting** on some or all of your trips?

☐ Yes ☐ No (**go to Q5**)

Q4. Which type of spin casting do you use? (**Please check one box only**)

☐ Artificial lures only  
☐ Bait only  
☐ Artificial lures and bait

Q5. Do you usually wade in the water when you fish at a river? (**Please check one box only**)

☐ Yes, most of the time  
☐ Yes, sometimes  
☐ Rarely  
☐ Never

Q6. Do you usually keep some of the fish you catch for consumption? (**Please check one box only**)

☐ Yes, I keep most of the fish I catch.  
☐ Yes, I occasionally keep some of the fish I catch.  
☐ No, I never keep any fish. I always release all fish I catch.

Q7. Please indicate how important the following characteristics are to you when you fish at a river.  
(**Please check one box for each row**)

	Not important at all	Somewhat important	Important	Very important
Solitude (no or few other anglers)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Easy access to the river (little or no hiking)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Beautiful Scenery	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Good chance to catch trout of ANY SIZE	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Good chance to catch LARGE trout (>12")	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Good chance to catch WILD trout	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
No bait restrictions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Regulations allow to keep some trout	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please note: Throughout this survey, we will use the term "**Fishing Season**". For compatibility across the two States of CA and NV, we define a fishing season in this survey as the time period from **April 15 – Sept. 30**.

Q8. For last year's (**2004**) fishing season, did you hold a **California annual fishing license** (or a combined annual hunting / fishing license)?

☐ Yes      ☐ No

Q9. For this year's (**2005**) season, which **annual fishing licenses** (or combined annual hunting / fishing licenses) are you holding? (**Please check one box only**)

- ☐ Nevada annual license ONLY
- ☐ California annual license ONLY
- ☐ Both of the above
- ☐ None of the above

**(Please continue on the next page)**

## ➤ Part II: Mudsnail Awareness and Containment

Q10. Have you heard of the NZMS problem before this survey?

- ☐ Yes      ☐ No (**go to Q.13**)

Q11. If yes, how did you hear about the NZMS? (**Please check all applicable boxes**)

- ☐ Media (newspaper, TV, fishing magazines)  
☐ Poster or flyer at trail head, fishing site, campground, or ranger station  
☐ Poster or flyer at retail store  
☐ Word to mouth (friends, other anglers etc)  
☐ Other: \_\_\_\_\_

Q12. Which snail-containing measures, if any, do you usually take? (**Please check all applicable boxes**)

- ☐ I avoid wading in the water as much as possible.  
☐ I dry my wading gear for several days before the next fishing trip.  
☐ I leave my wading gear in the hot sun for several hours before the next fishing trip.  
☐ I soak my wading gear in a special cleaning solution for at least 5 minutes after each trip.  
☐ I freeze my wading gear for several hours before the next fishing trip.  
☐ I use a designated set of wading gear for contaminated waters.

**(Go to Q.14)**

Q13. Experts have suggested the following containment measures to avoid spread of the snail:

- (i) Avoid wading in the water.  
(ii) Drying wading gear for several days before the next fishing trip OR  
(ii) Leaving wading gear in the hot sun for several hours before the next fishing trip OR  
(iii) Soaking wading gear in a special cleaning solution for at least 5 minutes after each trip OR  
(iv) Freezing wading gear for several hours before the next fishing trip.  
(v) Using a designated set of wading gear for contaminated waters.

Now that you know a bit more about the NZMS, do you think you will use any of these measures after each fishing trip? (**please check one box only**)

- ☐ Definitely yes.  
☐ Probably yes.  
☐ Probably not.  
☐ Definitely not.

Q14. In the last 2 years (**2004 and 2005** fishing seasons), have you fished at any of the following waters? (**Please check all applicable boxes**)

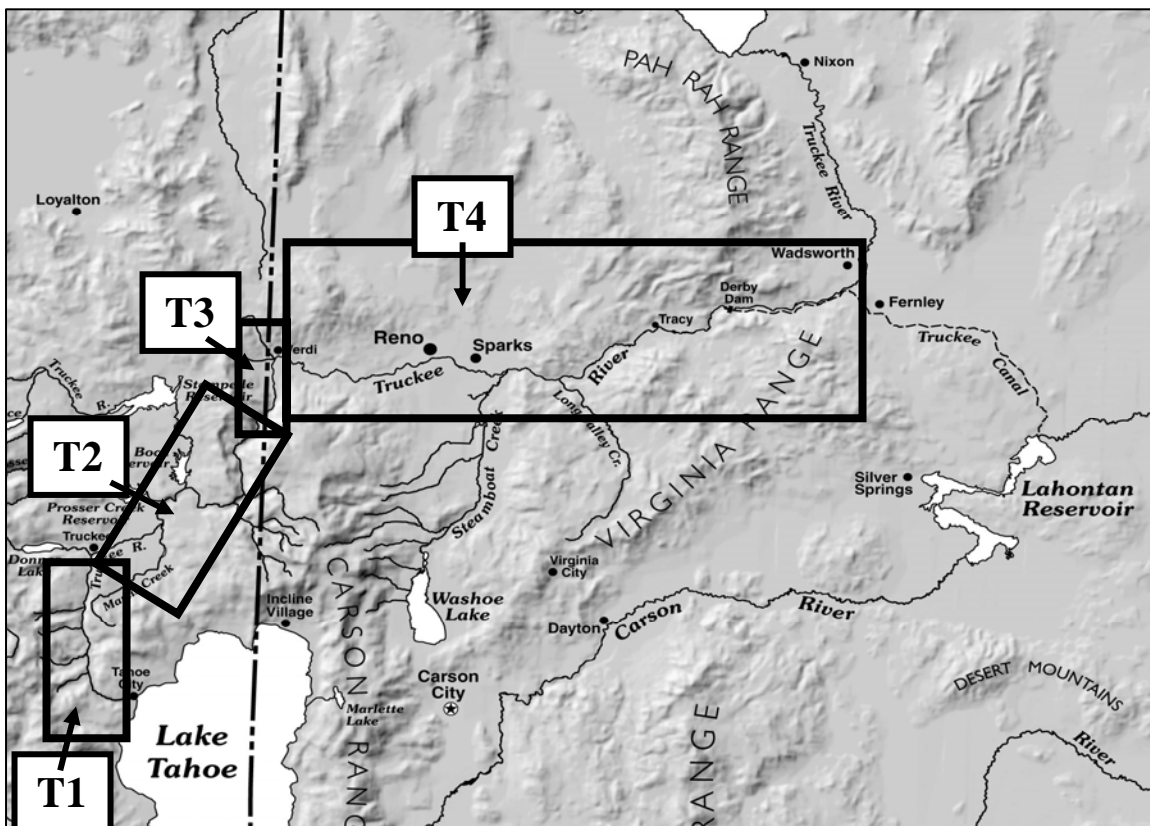
- ☐ Snake River in Idaho  
☐ Green, Bear, Provo, Weber, Ogden, and / or Logan River Basins in Utah  
☐ Owens River and / or tributaries in California  
☐ Firehole, Madison, Lower Gibbon River and /or Polecat Creek in or near Yellowstone National Park  
☐ Colorado River and / or tributaries below Glen Canyon Dam, Arizona

### ➤ Part III: Your Fishing History at the Truckee / Carson / Walker River

For the remainder of this survey we will refer to different sections of the TCW rivers. We divided each river into **four** sections. These sections are described and shown on the following pages. Please take some time to familiarize yourself with these sections.

First, let's look at the 4 sections of the **Truckee River**:

Truckee	section T1	section T2	section T3	section T4
State	California	California	Nevada	Nevada
detailed location	Lake Tahoe to Trout Creek	Trout Creek to Stateline	Stateline to I-80 Bridge at Verdi	I-80 Bridge at Verdi to Reservation Line
current fishing regulations	general regulations	2 trout, min. 15 inches, artificial lures	2 trout, min. 14 inches, artificial lures	general regulations

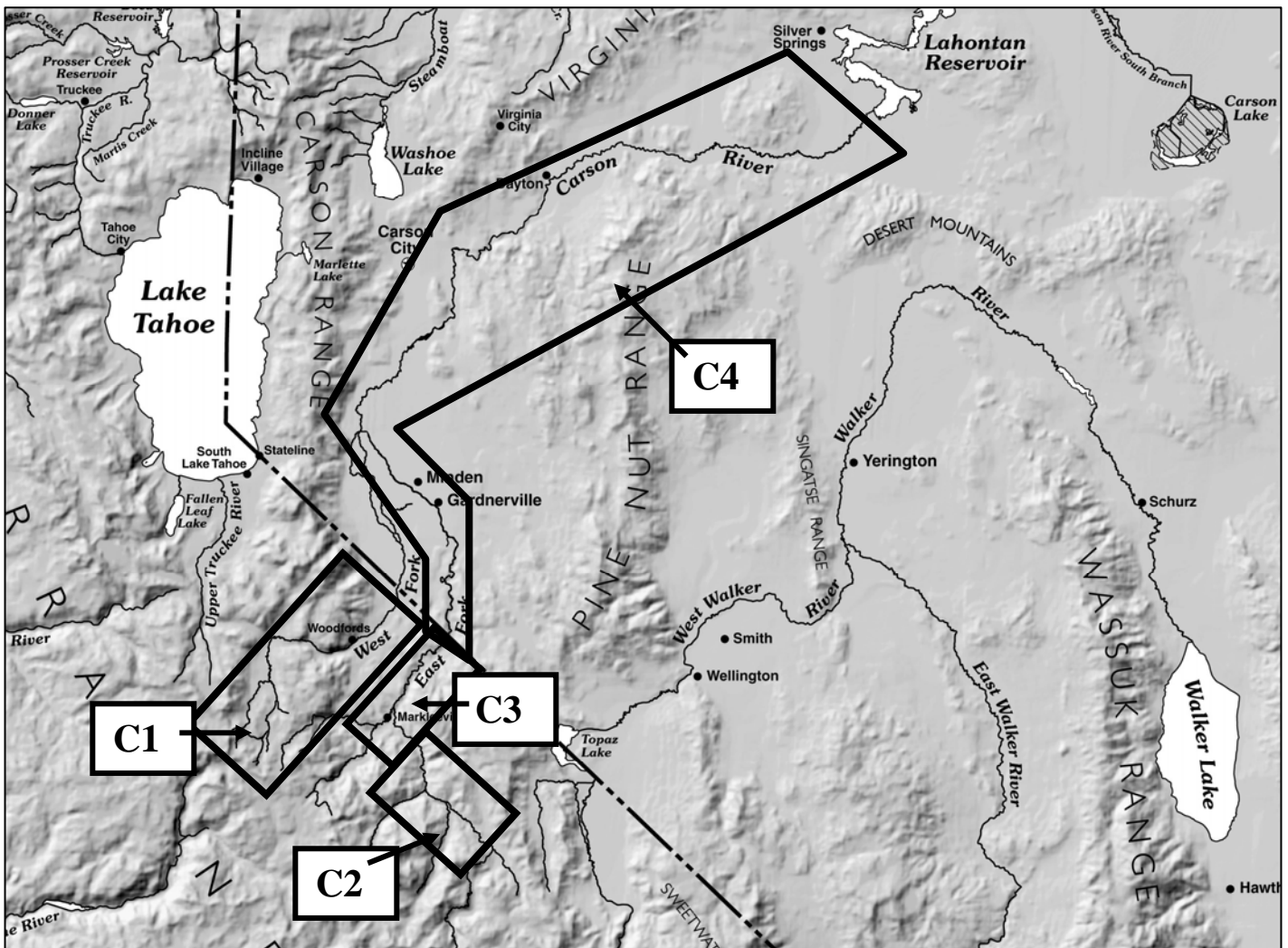


(map courtesy of the NV Bureau of Mines and Geology)

(Please continue on the next page)

Here are the 4 sections for the **Carson River**:

<b>Carson</b>	<b>section C1</b>	<b>section C2</b>	<b>section C3</b>	<b>section C4</b>
<b>State</b>	<b>California</b>	<b>California</b>	<b>California</b>	<b>Nevada</b>
<b>detailed location</b>	West Fork of the Carson River, CA side	East Fork above Hangman Bridge	East Fork, Hangman Bridge to Stateline	East Fork below Stateline and Main Carson River
<b>current fishing regulations</b>	general regulations	general regulations	catch & release, artificial lures	general regulations



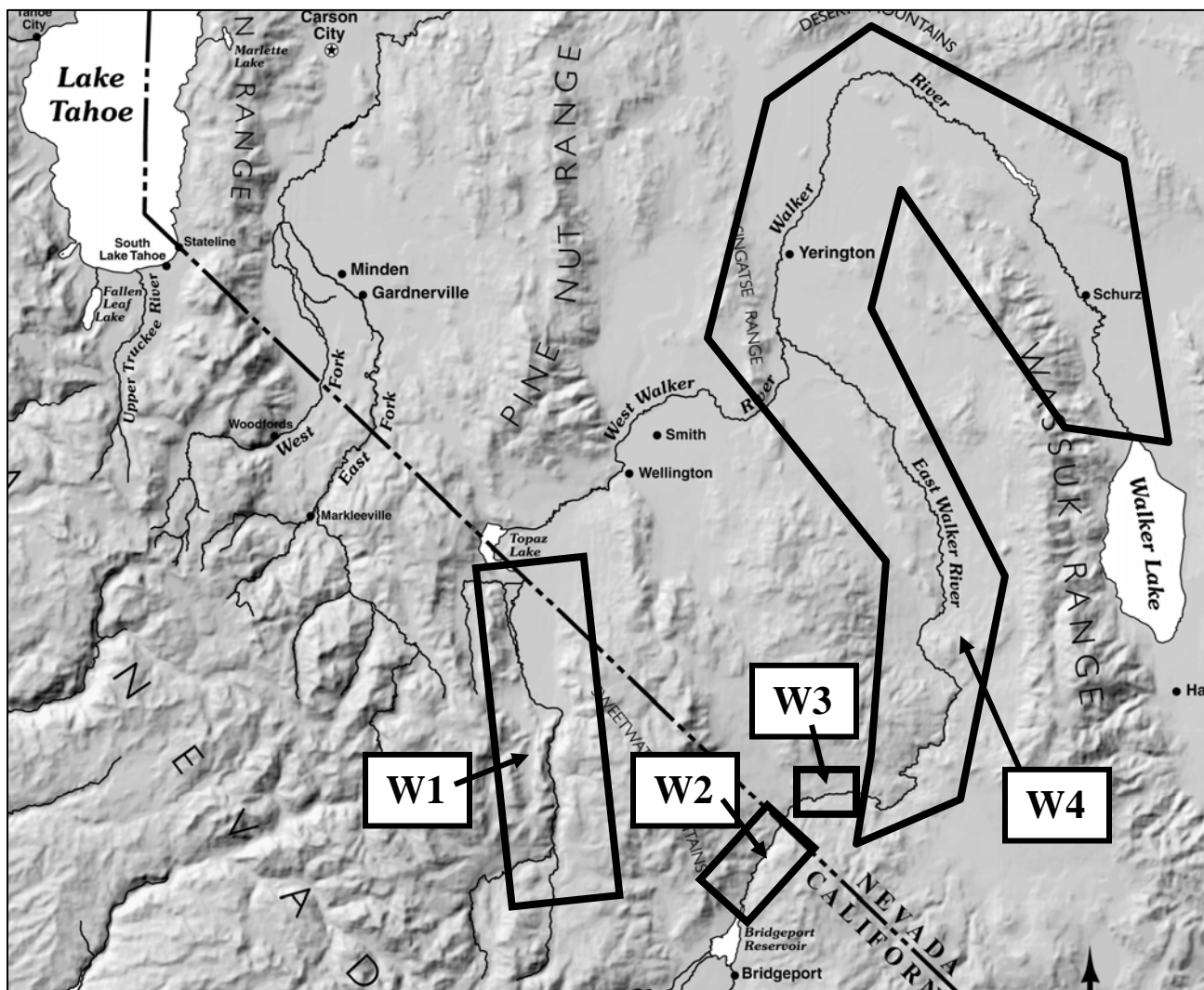
(map courtesy of the NV Bureau of Mines and Geology)

(Please continue on the next page)



And these are the 4 sections of the **Walker River**:

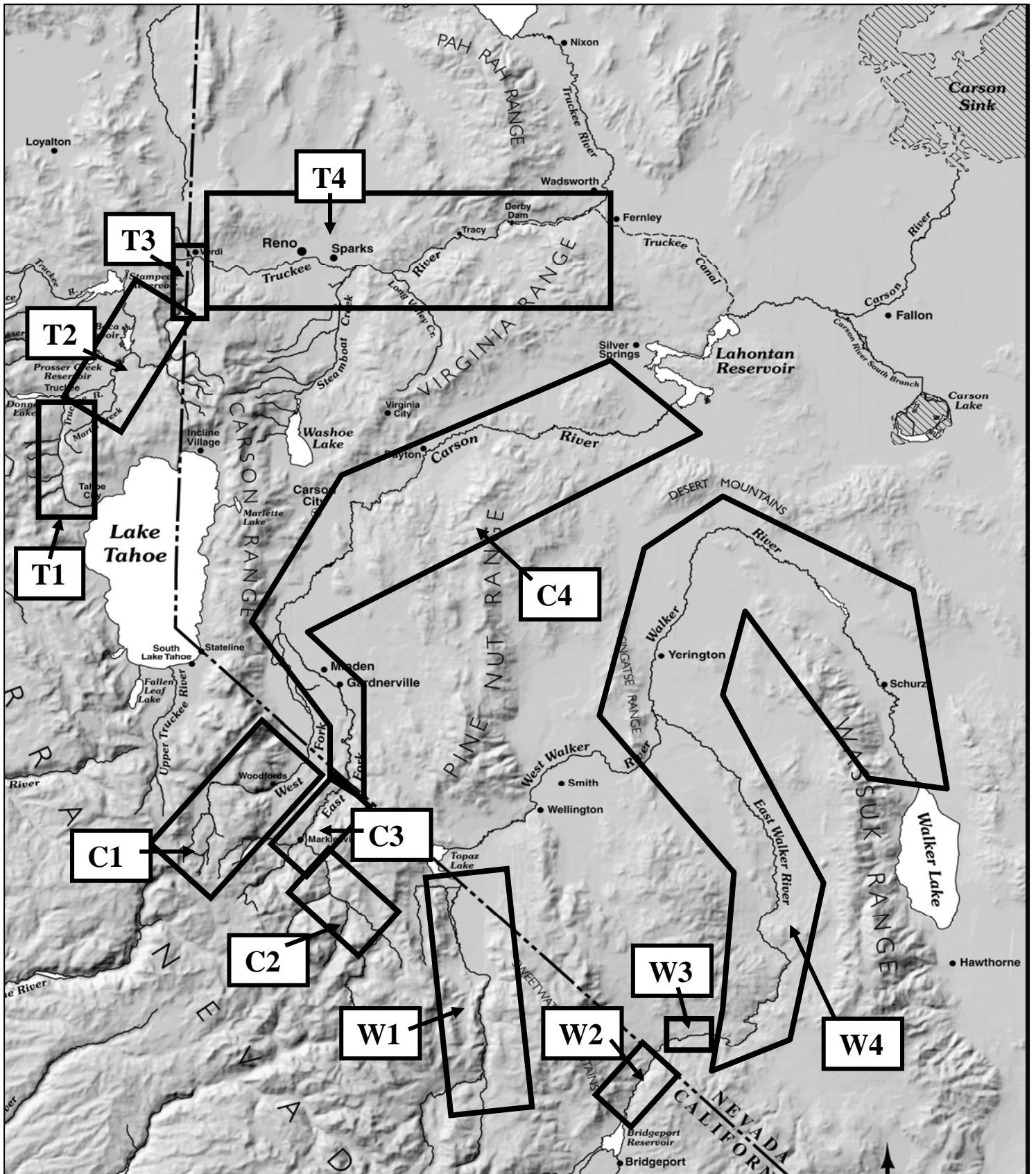
Walker	section W1	section W2	section W3	section W4
State	California	California	Nevada	Nevada
detailed location	West Fork of the Walker River to Topaz Lake	East Fork – Bridgeport Dam to Stateline	East Fork – Rosaschi Ranch area	Downstream from Rosaschi Ranch (incl. Elbow, Raccoon Beach, Zanis Beach)
current fishing regulations	general regulations	1 trout, min. 18 inches, artificial lures	catch & release, artificial lures	general regulations



(map courtesy of the NV Bureau of Mines and Geology)

(Please continue on the next page)

Here is an overview of **all 12 sections**:



(map courtesy of the NV Bureau of Mines and Geology)

We would like to know more about the number of **day trips** you made to each of these sections in the 2004 and 2005 seasons.

We define a **day trip** as a trip with the **main purpose to fish**, where departure and return to home is on the same calendar day (no overnight stay). The fishing trip may last just an hour or all day long – in either case you should count it as a "day trip".

Please note: If you visited several sections on a single day trip, only count the trip towards the section where you spent **most of your time** on that trip. *For example, if you fished section T3 on the Truckee for 3 hours, and section T4 for 1 hour on the **same day**, count the trip towards section T3 only.*

Please remember that we define a "season" to last from **April 15 to Sept. 30**.

We will ask you to enter your trip counts into tables like the ones shown below. Here is an example: Let's assume that in the **2004** season, you took **6 day trips** to the Nevada trophy section of the Truckee (section T3), **3 day trips** to the West Fork of the Carson (section C1), and **2 day trips** to section W2 of the Walker river. In **2005**, you took **5 trips to T3**, **3 trips to T4**, **4 trips to C2**, and **1 trip to W3**. You would enter these trips as follows: (*Note: You do NOT need to enter zero ("0") if you didn't take a trip – simply leave the field blank*)

For the Truckee River:

Day Trips to the Truckee River	2004 Season	2005 Season
<b>Section T1</b> (Lake Tahoe to Trout Creek, California)		
<b>Section T2</b> (Trout Creek to Stateline, California)		
<b>Section T3</b> (Stateline to I-80 Bridge at Verdi, Nevada)	6	5
<b>Section T4</b> (I-80 Bridge at Verdi to Reservation Line, Nevada)		3

For the Carson River:

Day Trips to the Carson River	2004 Season	2005 Season
<b>Section C1</b> (West Fork of the Carson River, California)	3	
<b>Section C2</b> (East Fork above Hangman Bridge, California)		4
<b>Section C3</b> (East Fork, Hangman Bridge to Stateline, California)		
<b>Section C4</b> (East Fork below Stateline and Main Carson River, Nevada)		

For the Walker River:

Day Trips to the Walker River	2004 Season	2005 Season
<b>Section W1</b> (West Fork of the Walker River, California)		
<b>Section W2</b> (Bridgeport Dam to Stateline, California)	2	
<b>Section W3</b> (Rosaschi Ranch area, Nevada)		1
<b>Section W4</b> (Downstream from Rosaschi Ranch, incl. Elbow, Raccoon Beach, Zanis Beach, Nevada)		

Now let's look at your actual **day trips** for the **2004 and 2005** seasons (April 15 – Sept. 30):

Q15. Let's first look at the **Truckee River**. To your best recollection, how many **day trips** did you take to the 4 sections of the Truckee during **each of the 2004 and 2005 seasons**?

Day Trips to the Truckee River	2004 Season	2005 Season
<b>Section T1</b> (Lake Tahoe to Trout Creek, California)		
<b>Section T2</b> (Trout Creek to Stateline, California)		
<b>Section T3</b> (Stateline to I-80 Bridge at Verdi, Nevada)		
<b>Section T4</b> (I-80 Bridge at Verdi to Reservation Line, Nevada)		

Q16. If you took any trips to the general regulation section on the **Truckee** on the Nevada side (section **T4**) in 2004 or 2005, which part of this section did you fish most often? (**Please check one box only**)

- ☐ Verdi to West McCarran Bridge
- ☐ Urban Reno and Sparks (between West McCarran and East McCarran Bridge)
- ☐ Between Sparks and Derby Dam
- ☐ Below Derby Dam

(Please continue on the next page)

Q17. Now let's focus on the **Carson River**. To your best recollection, how many **day trips** did you take to the 4 sections of the Carson during **each of the 2004 and 2005 seasons**?

<b>Day Trips to the Carson River</b>	<b>2004 Season</b>	<b>2005 Season</b>
<b>Section C1</b> (West Fork of the Carson River, California)		
<b>Section C2</b> (East Fork above Hangman Bridge, California)		
<b>Section C3</b> (East Fork, Hangman Bridge to Stateline, California)		
<b>Section C4</b> (East Fork below Stateline and Main Carson River, Nevada)		

Q18. If you took any trips to the general regulation section on the **Carson** on the Nevada side (section **C4**) in 2004 or 2005, which part of this section did you fish most often? (**Please check one box only**)

- ☐ Stateline to Gardnerville
- ☐ Urban Minden and Gardnerville
- ☐ Between Minden and Dayton
- ☐ Below Dayton

Q19. Now let's focus on the **Walker River**. To your best recollection, how many day trips did you take to the 4 sections of the Walker during **each of the 2004 and 2005 seasons**?

<b>Day Trips to the Walker River</b>	<b>2004 Season</b>	<b>2005 Season</b>
<b>Section W1</b> (West Fork of the Walker River, California)		
<b>Section W2</b> (Bridgeport Dam to Stateline, California)		
<b>Section W3</b> (Rosaschi Ranch area, Nevada)		
<b>Section W4</b> (Downstream from Rosaschi Ranch, incl. Elbow, Raccoon Beach, Zanis Beach, Nevada)		

Q20. If you took any trips to the general regulation section on the **East Walker** on the Nevada side (section **W4**) in 2004 or 2005, which part of this section did you fish most often? (**Please check one box only**)

- ☐ The Elbow
- ☐ Between Elbow and confluence with the West Walker (incl. Raccoon, Zanis)
- ☐ Below the confluence with the West Walker

Q21. Now let's look at your **overnight fishing trips** (with at least 1 night spent away from home) to the three rivers. Approximately how many overnight trips did you take **to the 12 sections of the TCW system** in the 2004 and 2005 seasons?

Overnight trips in 2004: \_\_\_\_\_

Overnight trips in 2005: \_\_\_\_\_

Q22. Approximately how many trips did you take to **other rivers and lakes in California or Nevada in the 2004 and 2005 seasons?**

<b>Other Rivers and Lakes in CA, NV</b>	<b>2004 Season</b>	<b>2005 Season</b>
<b>Day Trips</b>		
<b>Overnight Trips</b>		

**(Please continue on the next page)**

## ➤ Part IV: Your Fishing Decisions Under Hypothetical Quality Changes

In this section, we would like to know how your decision to purchase an annual license and to take fishing trips might be affected if fishing regulations were to change at any of the 12 TCW river sections. Such changes might be triggered by a NZMS infestation. Specifically, a potential arrival of the NZMS **may** prompt managing agencies to take one or more of the following regulatory actions:

(Please note that these actions are purely hypothetical and do not in any way reflect planned fishery management strategies by the Nevada Department of Wildlife, the California Department of Fish and Game, or any other State or Federal agency)

**Regulatory Action 1: A tightening of bag / size / and lure restrictions to ease fishing pressure on trout.**

*Example:* A section that is currently under "general regulations" or "restricted" might become "catch & release" only. We define these terms as follows:

<b>Bag / Size / Lure Regulations</b>	
<b>Levels</b>	<b>Definition of Levels</b>
General	Bag limit is <b>5 trout</b> , no size or lure restrictions
Restricted	Bag limit is <b>2 trout</b> , min. size of 15 ", artificial lures only
Catch & Release	Bag limit is <b>0 trout</b> , artificial lures only

**Regulatory Action 2: A temporary or seasonal closure of a section to all fishing**

Such a ban could be imposed as a last resort measure to lower the risk of introduction of the snail to that section, or to lower the risk of the spread of the snail by humans to other waters if it already occurs in that section.

In the following, we will ask you how each of these hypothetical regulatory actions would affect your decision to purchase an annual fishing license and to take fishing trips to the TCW system in a near-future fishing season. We will start with hypothetical changes in **bag / size / and lure regulations**.

## Your license purchase and trip decisions under changes in **Bag / Size / Lure regulations**:

For this part of the survey, we will focus on the three "**general regulation**" sections of the TCW system as defined previously that are located in **Nevada**. These are sections **T4, C4, and W4**. (*Feel free to go back to the maps to revisit the location of these sections*).

Q23. Consider first the **section T4**, the Nevada general regulation section of the Truckee from Verdi to Reservation Line. If this section were to become a section with **catch & release regulation** in a near-future fishing season, but all other sections remain under current regulations, how would this affect your decision to purchase an annual fishing license for Nevada? (**Please check one box only**)

- ☐ It would not affect my decision to purchase a NV annual license at all.
- ☐ I would be *more* likely to purchase a NV annual license.
- ☐ I would be *less* likely to purchase a NV annual license.
- ☐ I would definitely *not purchase* a NV annual license.

Q24. How would this affect the **number of fishing trips** (day or overnight) you would make to this section? (**please check one box only**)

- ☐ I would not affect the number of trips I would make to this section.
- ☐ I would likely take *more* trips to this section than in past seasons.
- ☐ I would likely take *fewer* trips to this section than in past seasons.
- ☐ I would *not take any trips* to this section.

Q25. Now consider first the **section C4**, the Nevada general regulation section of the East Fork of the Carson and Main Carson River below Stateline. If this section were to become a section with **catch & release regulation** in a near-future fishing season, but all other sections remain under current regulations, how would this affect your decision to purchase an annual fishing license for Nevada? (**Please check one box only**)

- ☐ It would not affect my decision to purchase a NV annual license at all.
- ☐ I would be *more* likely to purchase a NV annual license.
- ☐ I would be *less* likely to purchase a NV annual license.
- ☐ I would definitely *not purchase* a NV annual license.

Q26. How would this affect the **number of fishing trips** (day or overnight) you would make to this section?

- ☐ I would not affect the number of trips I would make to this section.
- ☐ I would likely take *more* trips to this section than in past seasons.
- ☐ I would likely take *fewer* trips to this section than in past seasons.
- ☐ I would *not take any trips* to this section.

(Please continue on the next page)



Q27. Now consider **section W4**, the Nevada general regulation section of the East Fork of the Walker River and the Main Walker River. If this section were to become a section with **catch & release regulation** in a near-future fishing season, but all other sections remain under current regulations, how would this affect your decision to purchase an annual fishing license for Nevada? **(Please check one box only)**

- ☐ It would not affect my decision to purchase a NV annual license at all.
- ☐ I would be *more* likely to purchase a NV annual license.
- ☐ I would be *less* likely to purchase a NV annual license.
- ☐ I would definitely *not purchase* a NV annual license.

Q28. How would this affect the **number of fishing trips** (day or overnight) you would make to this section?

- ☐ I would not affect the number of trips I would make to this section.
- ☐ I would likely take *more* trips to this section than in past seasons.
- ☐ I would likely take *fewer* trips to this section than in past seasons.
- ☐ I would *not take any trips* to this section.

**(Please continue on the next page)**

## Your license purchase and trip decisions under **section closures**:

For this part of the survey, we will focus on the following three sections: **T3, T4, and W3**. (*Feel free to go back to the maps to revisit the location of these sections*).

Q29. Let's first consider **section T3**, the Nevada Trophy section of the Truckee River between Stateline and the I-80 Bridge at Verdi. If section T3 were to be closed to all fishing in a near-future fishing season, but all other sections remain open and under current regulations, how would this affect your decision to purchase an annual fishing license for Nevada? (**Please check one box only**)

- ☐ It would not affect my decision to purchase NV annual license at all.
- ☐ I would be *less* likely to purchase a NV annual license.
- ☐ I would *definitely not purchase* a NV annual license.

Q30. How would this closure affect the total number of fishing trips (day or overnight) you would make during that season? (**please check only one box**)

- ☐ I never fish at section T3, so my overall number of fishing trips would not be affected.
- ☐ I would take fewer fishing trips overall.
- ☐ I would make up for the lost trips to section T3 primarily by taking more trips to other sections **within** the Truckee / Carson / Walker system.
- ☐ I would make up for the lost trips to section T3 primarily by taking more trips to other fishing destinations **outside** the Truckee / Carson / Walker system.

Q31. Now consider **section T4**, the Nevada general regulation section of the Truckee from Verdi to Reservation Line. If section T4 were to be closed to all fishing in a near-future fishing season, but all other sections remain open and under current regulations, how would this affect your decision to purchase an annual fishing license for Nevada? (**Please check one box only**)

- ☐ It would not affect my decision to purchase NV annual license at all.
- ☐ I would be *less* likely to purchase a NV annual license.
- ☐ I would *definitely not purchase* a NV annual license.

Q32. How would this closure affect the number of fishing trips (day or overnight) you would make during that season? (**please check only one box**)

- ☐ I never fish at section T4, so my overall number of fishing trips would not be affected.
- ☐ I would take fewer fishing trips overall.
- ☐ I would make up for the lost trips to section T4 primarily by taking more trips to other sections **within** the Truckee / Carson / Walker system.
- ☐ I would make up for the lost trips to section T4 primarily by taking more trips to other fishing destinations **outside** the Truckee / Carson / Walker system.

(Please continue on the next page)

Q33. Now consider **section W3**, the Rosaschi Ranch area on the East Fork of the Walker River. If section W3 were to be closed to all fishing in a near-future fishing season, but all other sections remain open and under current regulations, how would this affect your decision to purchase an annual fishing license for Nevada? (**Please check one box only**)

- ☐ It would not affect my decision to purchase NV annual license at all.
- ☐ I would be *less* likely to purchase a NV annual license.
- ☐ I would *definitely not purchase* a NV annual license.

Q34. How would this closure affect the number of fishing trips (day or overnight) you would make during that season? (**please check only one box**)

- ☐ I never fish at section W3, so my overall number of fishing trips would not be affected.
- ☐ I would take fewer fishing trips overall.
- ☐ I would make up for the lost trips to section W3 primarily by taking more trips to other sections **within** the Truckee / Carson / Walker system.
- ☐ I would make up for the lost trips to section W3 primarily by taking more trips to other fishing destinations **outside** the Truckee / Carson / Walker system.

(Please continue on the next page)

## ➤ Part V: Your Typical Trip Expenditures

Q35. On a typical **day trip**, how much do you usually spend on the following items:

- ☐ Food and beverages purchased "on the road": \$\_\_\_\_\_
- ☐ Gasoline: \$\_\_\_\_\_
- ☐ Tackle and bait (or flies / artificial lures) for that day: \$\_\_\_\_\_

Q36. On a typical **overnight trip**, how much do you usually spend on the following items:

- ☐ Accommodation: \$\_\_\_\_\_
- ☐ Food and beverages purchased "on the road": \$\_\_\_\_\_
- ☐ Gasoline: \$\_\_\_\_\_
- ☐ Tackle and bait (or flies / artificial lures) per trip: \$\_\_\_\_\_

## ➤ Part VI: Some Information About Yourself

Q37. What is your gender?

- ☐ Female                      ☐ Male

Q38. What is your age?

\_\_\_\_\_years

Q39. Which of the following best describes your household? (**Please check one box only**)

- ☐ Household with children
- ☐ Single, no children
- ☐ Couple, no children
- ☐ Multiple adults, no children

Q40. What is the highest level of education that you have *completed*? (**Please check one box only**)

- ☐ Elementary school
- ☐ Jr. High School
- ☐ High School
- ☐ 2 years of College
- ☐ 4 years of College
- ☐ Graduate or Professional school

Q41. Approximately what was your annual household income before taxes in 2004?

- |  |  |  |
|--|--|--|
| <input type="checkbox"/> Less than \$20,000  | <input type="checkbox"/> \$100,000 - \$119,999 | <input type="checkbox"/> \$200,000 - \$224,999 |
| <input type="checkbox"/> \$20,000 - \$39,999 | <input type="checkbox"/> \$120,000 - \$139,999 | <input type="checkbox"/> \$225,000 - \$249,999 |
| <input type="checkbox"/> \$40,000 - \$59,999 | <input type="checkbox"/> \$140,000 - \$159,999 | <input type="checkbox"/> \$250,000 - \$274,999 |
| <input type="checkbox"/> \$60,000 - \$79,999 | <input type="checkbox"/> \$160,000 - \$179,999 | <input type="checkbox"/> \$275,000 - \$300,000 |
| <input type="checkbox"/> \$80,000 - \$99,999 | <input type="checkbox"/> \$180,000 - \$199,999 | <input type="checkbox"/> Over \$300,000        |

Thank you very much for your participation!

Please return this questionnaire as soon as possible in the enclosed postage-paid envelope.

If you have any comments on this survey, please enter them below. We would certainly appreciate your feedback.

Comment